Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

A56.9
R31
cop.2

ABSTRACTS

of recent published material on Soil and Water Conservation

Number 35

ARS 41-75-11
Agricultural Research Service

UNITED STATES DEPARTMENT OF AGRICULTURE

ARS-41-75-11 Issued June 1965

The "ABSTRACTS of recent published material on Soil and Water Conservation" are issued at irregular intervals. Their purpose is to bring together a summary of current published information about soil and water conservation work. Reprints of abstracted articles are gnerally not available in the Soil and Water Conservation Research Division. Requests for reprints should be sent to the authors or institutions, addresses are appended.

The classification of articles follows the table of contents used for the "Soil and Water Conservation Research Needs" of the Soil Conservation Service. Abstracted articles are not editorialized and the language of the author is used wherever possible. In foreign articles, the units of measure are converted to usual American units. Tables are included where they help to present the information. When the entire number of a publication is devoted to reviewing one subject then the entire publication is abstracted as one article giving title and authors of each paper included in the publication. Abbreviations of journals and addresses follow U.S.D.A. Misc. Pub. 765, July 1958.

This is the 35th of the publications issued by the SCS or ARS under this title. The first 15 issues and numbers 17 and 25 are out of print.

Those available for distribution are:

(16)	ARS-41-35	Aug.	1959
(18)	ARS-41-39	Oct.	1960
(19)	ARS-41-45	Apr.	1961*
(20)	ARS-41-46	May	1961*
(21)	ARS-41-50	Aug.	1961
(22)	ARS-41-58	May	1962
(23)	ARS-41-67	Jan.	1963
(24)	ARS-41-71	Apr.	1963*
(26)	ARS-41-75-2	Nov.	1963
(27)	ARS-41-75-3	Mar.	1964
(28)	ARS-41-75-4	Apr.	1964
(29)	ARS-41-75-5	July	1964
(30)	ARS-41-75-6	Oct.	1964
(31)	ARS-41-75-7	Feb.	1965
(32)	ARS-41-75-8	Apr.	1965
(33)	ARS-41-75-9	Apr.	1965
(34)	ARS-41-75-10	May	1965

*Reserved for libraries and institutions.

Soil Conservation Service personnel should address requests for additional copies of ABSTRACTS to the appropriate State Conservationist.

Authors of articles and reports in the field of soil and water conservation are urged to supply abstracts, reprints, or copies to the abstractor:

Charles B. Crook, Soil and Water Conservation Research Division, Agricultural Research Service, U.S. Department of Agriculture, Plant Industry Station, Beltsville, Maryland, 20705.

CONTENTS

WATERSHED ENGINEERING

	Page Number	Index Number
Watershed development	1	1-12
Hydrology	2	13-14
Geology	2	15-19
Engineering design	5	20-25
Ground water recharge	7	26-27
Snow surveys	8	-

WATER MANAGEMENT

Irrigation	8	28-43
Drainage	16	44-55
Evaluation of flood water damage	20	-
Storage and conveyance	20	56-58

BASIC SOIL SCIENCE

Soil physics	22	59-72
Soil chemistry and minerology	28	73-87
Soil biology	33	88-100
Soil-plant-animal relationships	39	101-117
Soil classification	45	118-130

EROSION CONTROL

Erosion equation	50	131
Wind and water erosion	50	132-137
Strip cropping	53	-
Terracing	53	138
Critical areas	54	139-142

SOIL MANAGEMENT

Cropping practices	56	143-152
Crop residue management	59	153
Tillage	59	154
Fertility requirements for conservation farming	60	155-165
Salinity and alkali problems	66	166-169
Cover crops and green manure crops	68	-
Climatic influences	68	170-175
Surface soil removal	71	176
Mulching	71	177-180

PLANT MANAGEMENT

Pasture and haylands	73	181-192
Rangelands	78	193-199
Plant materials	81	200-202
Woodlands	83	203-206
Windbreaks	85	207-208
Fruit and nut crops	85	209-213
Field crops	87	214-222
Vegetable crops	91	223-226

Page Number Index Number

ECONOMIC AND SOCIAL ASPECT OF SOIL AND WATER CONSERVATION

Costs and returns. 93 227-263
Institutional, educational, and social factors affecting conservation application 100 264-286

BIOLOGY

Fish 102 287-293
Upland wildlife. 105 294-295
Wetland wildlife 106 296-298

SUPPLEMENT

Problems indirectly affecting the application of soil and water conservation practices . . 107 299-315
Radioactive fallout. 110 316-318

Mention of a proprietary product in this publication does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture and does not imply its approval by the Department to the exclusion of other products that may also be suitable.

Caution: If pesticides are handled or applied improperly, or if unused parts are disposed of improperly, they may be injurious to humans, domestic animals, desirable plants, pollinating insects, fish or other wildlife, and may contaminate water supplies. Use pesticides only when needed and handle them with care. Follow the directions and heed all precautions on the container label.

WATERSHED ENGINEERING

Watershed Development

SEE ALSO 55, 139, 231, 232, 233, 237, 246, 285.

1. Brown, C. B. WATERSHED DEVELOPMENT IN WEST GERMANY. J. Soil and Water Conserv. 19(2): 74-76. 1964.

Though some of the basic concepts of runoff control and management of land to curb erosion have a long history in Western Europe, the Western European nations are just now beginning to plan and to execute plans for the comprehensive multipurpose development of watersheds and river basins. Concepts of small watershed projects that began to crystallize in the United States in the thrities and that have been progressively maturing since the late forties did not take root in Europe until the midfifties.

The planning and development of multipurpose watershed projects in West Germany that are generally similar to those being carried out in the United States under the provisions of the Watershed Protection and Flood Prevention Act of 1954 were described.

Deceased. Former Administrator of Watersheds, SCS, USDA, Washington, D.C., 20250

Soil Conservation. 29(9): 195-216. 1964.

The April issue of Soil Conservation was devoted to articles on watershed projects. The following list presents the author, title, and address of author of each article.

2. Young, G. FLOODS ARE BEING PREVENTED WATERSHED BY WATERSHED. SCS, USDA, Washington, D.C., 20005
3. Stafford, I. B., and Ward, A. D. BUFFALO CREEK FIRST OF 11 EARLY FLOOD PREVENTION PROJECTS DONE. Jr. Author, SCS, USDA, East Aurora, N.Y.
4. Apmann, R. P. RESEARCH SEEKS BEST TECHNIQUES FOR STABILIZING STREAM CHANNELS. SWCRD, ARS, USDA, East Aurora, N.Y., 14052
5. Alverson, K. FLOOD-PROOFING PAYS OFF FOR INDIANA FARMERS AND THEIR TOWNS. SCS, USDA, Milwaukee, Wis.
6. Heard, W. L. YAZOO-LITTLE TALLAHATCHIE IS A PAYING FLOOD PREVENTION PROJECT. SCS, USDA, Jackson, Miss.
7. Johnson, L. E. FIVE KANSAS WATERSHED PROJECTS JOINED IN FLOOD--OTHER BENEFITS. SCS, USDA, Saline, Kans.
8. Williams, H. R. ARKANSAS WATERSHED TEAM SPEEDS FLOOD PREVENTION AND RECREATION. SCS, USDA, Washington, D.C., 20005
9. Lindberg, H. R. LITTLE SIOUX FLOOD PREVENTION. SCS, USDA, Cherokee, Iowa.
10. Loreen, E., and Boddy, H. WASHINGTON FARMERS SOLVING PROBLEM OF TOO MUCH WATER. SCS, USDA, Snohomish, Wash.
11 Work, R. A., and Shannon, W. G. SNOW SURVEY REPORTS HELP WEST IN YEARS OF FLOODS OR DROUGHT. SCS, USDA, Portland, Oreg.
12. Beach, D. B. COLORADO SMALL-WATERSHED DAMS STOP FLOODS--BRING RECREATION. SCS, USDA, Colorado Springs, Colo.

Hydrology

SEE ALSO 132, 134, 136, 139, 172, 175, 178.

13. Reinhart, K. G. EFFECT OF A COMMERCIAL CLEARCUTTING IN WEST VIRGINIA ON OVERLAND FLOW AND STORM RUNOFF. J. Forestry 62(3): 167-171. 1964.

A commercial clearcutting was made on a 74-acre gaged watershed on the Fernow Experimental Forest; skidroads were loggers' choice--without limitations as to grade or provisions for drainage. After-logging, infiltration rates in the watershed remained well above maximum rainfall intensities except on portions of the skidroads. Overland flow occurred only from the skidroads; it resulted from the combination of rain directly on the skidroads and interception of subsurface flow by the road cuts. Increased storm runoff in the growing seasons--up to a maximum of about $\frac{1}{2}$ area-inch in any one storm--was largely the result of decreases in field-moisture deficiency rather than changes in the proportions of surface and subsurface flow.

In judging hydrologic condition of logged areas, perhaps as much emphasis should be placed upon road conditions and forest-floor disturbance as upon the amount of timber cut and condition of the stand.

Northeastern Forest Expt. Sta., FS, USDA, Parsons, W. Va.

14. Kingsley, Q. S., and Shubeck, F. E. THE EFFECTS OF ORGANIC TRENCHING ON RUNOFF. J. Soil and Water Conserv. 19(1): 19-22. 1964.

A review of the literature and results obtained in an experiment on the effects of organic trenching on runoff were given.

A trenching tool that used wheat straw bales as an organic wedge was described and illustrated.

The use of organic trenching was compared with the following treatments: (1) Area subsoiled with a 2 inch wide point; (2) use of trench without organic trenching; (3) 20 lb. of nitrogen; (4) sweetclover planted with a small grain; and (5) check plot.

On the claypan soils studied, the moisture infiltration and water conservation were greatly increased through the use of the organic wedge.

Subsoiling with a conventional chisel was not a very effective method of increasing soil moisture reserves.

The sweetclover catch crop appeared to reduce soil moisture in the year it made its growth. However, the next year with the rainfall 3 inches above average, the amount of soil moisture under corn preceded by the sweetclover was about equal to that in the organic trenched plots at all points in the profile except at the 3-4 foot depth. At the 3-4 foot depth there was much more soil moisture in the organic trenched plots than in the sweetclover plots.

S. Dak. Agr. Expt. Sta., Brookings, S. Dak.

Geology

SEE ALSO 4, 20, 21, 22, 23, 24, 45, 46, 53, 169.

15. Stokes, W. L. INCISED, WIND-ALIGNED STREAM PATTERNS OF THE COLORADO PLATEAU. Amer. J. Sci. 262(6): 808-816. 1964.

Wind-aligned drainage results when streams are confined between longitudinal sand accumulations. All stages of formation are found in the central Colorado

Plateau, where numerous, relatively straight and parallel tributaries extend downwind from streams that are sources of sufficient sand. The older examples, in which the original confining dunes have disappeared, are incised to depths as great as 1800 feet. Most southward flowing streams are aligned and are much longer than northward flowing streams which are mostly non-aligned.

Climatic conditions favorable to formation of longitudinal dunes appear to have existed at least intermittently since the beginning of the last major uplift and period of incision of rivers in the Colorado Plateau. An average of about 1000 feet of sediment has been removed from the area since incision began. Assuming a rate of removal of 1 foot per thousand years places the beginning of incision at about one million years ago. Wind direction appears to have changed very little during this period.

U. Utah, Salt Lake City, Utah.

16. Lundgren, H., and Jonsson, I. G. SHEAR AND VELOCITY DISTRIBUTION IN SHALLOW CHANNELS. J. Hydraul. Div., ASCE 90 (HY 1): 1-21. Jan. 1964.

The distribution of the botton shear stresses in an open channel was found by various approximate methods. For a shallow channel, a fair approximation was obtained when the shear was assumed to correspond to the vertical depth. When the incline of the botton was appreciable, however, it was better to calculate the shear by measuring the depth at right angles to the bottom. A more consistent method was to let the shear correspond to the area between two bottom normals. However, these methods did not cinsider the transfer of shear (in the direction of flow) through the "depth lines." The proposed new method overcame this difficulty by assuming that there was no transfer of shear through the orthogonals to the lines of equal mean velocity. The other basic assumption was that the velocity distribution was logarithmic along the bottom normals, corresponding to the local friction velocity. For a plane bottom with a transverse slope of 30°, the shear stresses were 40 percent higher than found by conventional methods. The method could not be used on polygonal cross sections.

Coastal Engin. Lab., Tech. U. Denmark, Copenhagen, Denmark.

17. Long, F. W., and Bowie, A. J. SEDIMENT CONCENTRATIONS IN SELECTED RUNOFF EVENTS. Trans. ASAE 6(4): 279-281. 1963.

Three runoff events were selected to show the effects of different type storms on sediment concentrations and fractional components.

The runoff event of April 3, 1958, was a result of a high-intensity rainfall which caused high concentrations of fine materials.

The runoff event of February 18, 1961, was a result of a uniform, low-intensity rainfall which produced low to medium velocities. Due to the low to medium velocities, the sands concentrations were lower than normal.

The runoff event of February 20 to 22, 1961, followed an event that wetted the channels and watershed, and as a result of a long duration, low-intensity rainfall, produced high discharges and velocities. The low-intensity rainfall caused the concentration of fine material to be low, but the high channel velocities caused the concentrations of sands to be much higher than normal.

Jr. Author, SWCRD, ARS, USDA, Holly Springs, Miss., 38635

18. Pemberton, E. L. SEDIMENT INVESTIGATIONS--MIDDLE RIO GRANDE. J. Hydraul. Div., ASCE 90 (HY 2): 163-185. Mar. 1964.

The middle Rio Grande Valley in New Mexico extends approximately 163 river miles. A comprehensive data collection program was developed for use in a channel rectification plan that would alleviate the aggradation problem caused by sediment depositions. River ranges were resurveyed to determine the rates and volume of aggradation or degradation or both in the river channel and flood plain. Channel hydraulics and sediment data were collected at special reaches of the river not affected by natural or artificial restrictions such as bridges. As a result of special analyses, the modified Einstein procedure was adopted for computing the total sediment load at a single cross section for 301 special measurements.

The data were used to develop total sediment load rating curves and hydraulics and sediment transport relationships in the design of channel rectification in the Middle Rio Grande Valley.

Off. Chief Engin., Bur. Reclaim., Denver, Colo.

19. Davis, S. N. SILICA IN STREAMS AND GROUND WATER. Amer. J. Sci. 262(7): 870-891. 1964.

Information from published analyses of natural water were compared with the known laboratory behavior of silica. Although most analyses were of water from the United States, a wide variety of natural environments were represented. The following general conclusions were made:

1. The silica content was less variable than any of the other major dissolved constituents of natural water.
2. The amount of silica in ground water was primarily dependent on the rock and mineral types in contact with the water. Largest amounts were in association with volcanic rocks; intermediate amounts in association with plutonic rocks and sediments containing feldspar and volcanic rock fragments; small amounts of silica were found in water from marine sandstones; the least was from water in carbonate rocks. The median value of silica for ground water was 17 p.p.m. and for stream water, about 14 p.p.m. Concentrations of less than 3 p.p.m. were found only in lake and ocean water or water derived recently from rain or snow.
3. Data studied failed to show any marked influence on silica concentrations of pH, salinity, climatic regions, surface vegetation, or temperature variations unless about 35° C.
4. Stream water acquired most of its silica within a relatively short period of time, perhaps less than 3 days.
5. Total silica removed in solution from drainage basins by stream water was related directly to the total runoff from the basins.
6. Modern published analyses failed to show a greater mobility of silica in tropical streams and ground water than in waters of other climatic zones, with the possible exception of the artic.
7. Although other factors may be more significant, rates of silica removal from drainage basins suggest that laterization is not confined to tropical regions.

Stanford U., Stanford, Calif.

SEE ALSO 16, 18, 139, 296.

20. Huff, F. A., and Shangnon, S. A., Jr. RELATION BETWEEN PRECIPITATION DEFICIENCY AND LOW STREAMFLOW. J. Geophysical Res. 69(4): 605-613. 1964.

A study was made to determine whether low-flow frequency distributions in Illinois could be reliably estimated from meteorological data and geologic factors. The development of such a method was desirable because of the general lack of long-term streamflow records.

Use was made of 50-year records of precipitation from 62 locations and data from 12 stream-gage stations with 45-year or longer records. When the state was divided into six different geomorphic regions, the low-flow frequencies for any basin in each region could be reliably estimated by the precipitation frequency distribution and a geomorphic index.

The regional geomorphic indices were developed through use of data from the 12 basins with long streamflow records. The method developed is applicable for basins of any size, for recurrence intervals of 5 years or longer, and for drought durations of 12 months or longer. Although based upon Illinois data, the method should be applicable to other areas.

Ill. State Water Survey, Urbana, Ill.

21. Silvester, R. HYDRAULIC JUMP IN ALL SHAPES OF HORIZONTAL CHANNELS. J. Hydraul. Div., ASCE 90 (HY 1): 23-55. Jan. 1964.

A simple analytical solution was presented of the ratios of conjugate depth and energy loss in terms of the upstream Froude number for the hydraulic jump in horizontal rectangular, triangular, parabolic, circular, and trapezoidal channels. A semi-empirical solution was provided for the jump length in the same sections. Verification was obtained from other exact solutions for certain shapes and from experimental data available on all sections. The correlation was good, although further tests were indicated for certain channel shapes, especially in regard to jump length. The extra loss obtainable in open channels of non-rectangular shape and the economy of constructing sloping walls should encourage the use of such sections in stilling basins. Comparisions of prototype jumps with model reproductions is necessary to determine the effect of vorticity, turbulence, and aeration on the characteristics. Laboratory tests followed the analytical solution closely with the exception of a few anomalous results which could be due to the preceeding factors.

U. Western Australia, Nedlands, Australia.

22. Morel-Seytoux, H. J. DOMAIN VARIATIONS IN CHANNEL SEEPAGE FLOW. J. Hydraul. Div., ASCE 90 (HY 2): 55-79. Mar. 1964.

A general method was presented to calculate the seepage discharge from a channel of a complex shape. The method was based on use of Hadamard's formula for the variation of the Green's function when the shape of the region for which the Green's function was known had changed. The method was used to calculate the seepage from channels of a complex shape that may be considered almost trapezoidal (or triangular). A simple geometrical construction yields the trapezoidal (or triangular) equivalent channel from which the same quantity of water was lost. Graphs of seepage discharge in dimensionless form were given for trapezoidal and triangular channels.

Res. Engin., Calif. Res. Corp., LaHabra, Calif.

23. Langbein, W. B. GEOMETRY OF RIVER CHANNELS. J. Hydraul. Div., ASCE 90 (HY 2): 301-312. Mar. 1964.

Hydraulic principles, as developed in firm boundary channels, appear insufficient to explain the form and profile of river channels. In nature, stream channels attain a most probable state that must fulfill the necessary hydraulic laws, and in addition, fulfill its degrees of freedom by tendency to equal distribution among velocity, depth, width, and slope. This principle was tested by the use of three examples. Another example explored the accommodation of a river channel to changing discharge. The last example was that of a river free to adjust its profile, velocities, depths, and widths to accommodate the downstream increase in discharge. Each of these examples appeared to satisfy the postulate presented in this paper. The adjustment was toward minimum variance among the components of stream power.

Geol. Survey, U.S. Dept. Int., Washington, D.C.

24. Singh, K. P. NONLINEAR INSTANTANEOUS UNIT-HYDROGRAPHY THEORY. J. Hydraul. Div., ASCE 90 (HY 2): 313-347. Mar. 1964.

The proposed equation for instantaneous unit hydrographs (IUHs) contains the following physically-significant parameters: K_1, the overland storage-discharge factor; K_2, the channel storage-discharge factor; T, the time of concentration; and a functional parameter, $w(\tau)$, called the concentration-time diagram.

Analysis of hyetographs and hydrographs for various storms over six drainage basins indicated a definite relationship between the parameters T and K_2, and the instantaneous equivalent rainfall excess, R_e. Nonlinearities in the instantaneous unit hydrographs derived from surface-runoff hydrographs caused by different storms over the same drainage basin were accounted for by the parameters of the IUH equation. Procedures for the analysis of data to establish relations between the parameters and R_e, and the use of established relations to derive a surface-runoff hydrograph from a given effective hyetograph were explained and supplemented by examples.

Irrig. Dept., Lucknow United Providence, India.

25. Mateos, M. SOIL LIME RESEARCH AT IOWA STATE UNIVERSITY. J. Soil Mechanics and Found. Div., ASCE 90 (SM 2): 127-153. Mar. 1964.

Lime is one of several products that can be successfully used in the improvement of the engineering characteristics of soils. There are many factors affecting a soil-lime water system. The primary factors are differences in soil gradation, types of clay minerals, and amount of organic matter present in the soil, and the kind and amount of lime and other chemicals which are added to the soil. Some secondary factors include moisture content, manner of applying the lime, amount of compaction, delay of compaction after wet mixing, curing time, and curing temperature. A summary of the work done at Iowa State University during the period 1947-63 on the influence of these factors in soil-lime stabilization using soils and limes from many parts of the United States was presented. The effects of lime on the plasticity, shrinkage, strength, and swell characteristics of soils as well as the freeze-thaw and wet-dry resistance were studied. Basic and applied research and field trials were made in order to evaluate the different aspects of soil-lime stabilization.

Lime can be used with silty and clayey soils to modify some of their physicochemical characteristics and improve the soil as an engineering material. Small amounts of lime are needed for this modification of the soil properties. Generally from 1 percent to 3 percent. Lime can also be used to cement silty and clayey soils and produce a water-stable material. This cementation is produced by the formation of crystalline silicates, some of them analogous to those formed in concrete. The lime needed for cementation ranges between 2 percent and 8 percent.

Proj. Engin., Toran-Tippets, McCarthy, Stratton, Madrid, Spain.

Ground Water Recharge

26. Dvoracek, M. J., and Scott, V. H. GROUND-WATER FLOW CHARACTERISTICS INFLUENCED BY RECHARGE PIT GEOMETRY. Trans. ASAE 6(3): 262-265. 1963.

The evaluation of geometry of recharge pits and the correlation of its effect upon flow from such pits were studied.

Investigation of flow characteristics from 29 model pits was conducted and reported. The flow characteristics included the determination of the division of flow., i. e., side or bottom, the location of the free water surface, and the amount of flow from each of the simulated recharge pits. The determination of the division of flow was through the use of a dye stream which resulted in a flow line dividing the flow between the side and bottom of the pit. The following conclusions were drawn:

1. The location of the free water surface was not affected by changes in depth to an impermeable layer and only slightly by the shape of the recharge pit.
2. Flow through the side of the pit was materially greater by increasing the amount of flow area in the sides of the pit. This flow area was increased by changing the side slope from a steep slope to a gentle slope.
3. Flow through the side was not materially affected by the depth to an impermeable layer or by the depth to the water table.
4. The shape of the recharge pit was extremely important in order to achieve maximum and most efficient flow from the pit. Ideally, the greater the amount of wetted area in the sides of the pit, the greater the total flow from the pit.
5. Results obtained should assist in designing recharge pits where geometric proportions will be influenced by economic considerations.

Tex. Tech. Col., Lubbock, Tex.

27. Smith, S. C., and Bittinger, M. W. MANAGING ARTIFICIAL RECHARGE THROUGH PUBLIC DISTRICTS. J. Soil and Water Conserv. 19(1): 7-11. 1964.

Artificial recharge operations generally require group action, which commonly results in the formation of public districts. These districts are public corporations empowered by the state to accomplish certain purposes. Their flexibility and adaptability make them a desirable form of government for the planning, construction, financing, and operation of artificial recharge projects. Public districts, through democratic processes, allow those affected by district activities to have control and to make the basic decisions.

Certain characteristics should receive attention when new districts concerned with artificial recharge are formed. Boundaries should be delineated carefully with the help of adequate geologic and hydrologic information. Flexibility in the choice of assessment methods should be provided to take into account the varied physical influences on benefits, possible changes in district operations, and the objectives of the district. Power to set and enforce regulations and to provide educational services should be considered in the light of what needs to be accomplished. Voting qualifications should be given consideration when the enabling act is drawn, and provision should be made for hiring a qualified manager and professional staff and/or consultants.

Off. Sec., U.S. Dept. Army, Washington, D.C.

Snow Surveys

SEE 11.

WATER MANAGEMENT

Irrigation

SEE ALSO 47, 50, 72, 143, 144, 151, 171, 185, 202, 218, 228, 235, 236, 254, 296.

28. Halkias, N. A. EVALUATING WATER DEFICIENCY OF PLANTS WITH VARIATIONS OF CLIMATE. Trans. ASAE 6(4): 338-339. 1963.

Evaluation of deficiency of water for cultivated plants in mainly dependent on water use by crops which is essentially a problem of evaluating water use by crops from climatic data.

The author discussed the most widely used methods for determining water use by crops from climatic data and concluded that:

1. The Blaney-Criddle method was developed primarily to estimate seasonal water use by crops. Application of this method with a constant coefficent gave a considerable deviation from measured consumptive use.
2. Estimates based on Thornthwaite's method were quite variable depending on the type of climate.
3. Penman's method should be used for crops which are fully shading the ground. The variable coefficients suggested for determing the monthly water needs during the summer season, diminish the possibility for wide use of this method.
4. The atmometer method could be used very satisfactorily for determining water needs for most irrigated crops during the summer season. Since the crop coefficient remained quite constant throughout the season, estimates of monthly water needs or of maximum water use based on this method should be quite reliable.
5. In designing irrigation systems and planning irrigation programs it was necessary to estimate the maximum deficiency of water for cultivated plants and consequently the maximum water use by crops. In this case, the atmometer method gave the best results.

U. Thessaloniki, Thessaloniki, Greece.

29. Frost, K. R. FACTORS AFFECTING EVAPOTRANSPIRATION LOSSES DURING SPRINKLING. Trans. ASAE 6(4): 282-283, 287. 1963.

Evapotranspiration during sprinkling was approximately equal to non-sprinkling periods since evaporation from the surface areas replaced normal transpiration of the plants.

Evapotranspiration losses during sprinkling should not be added to spray losses at wind velocities under 5 m.p.h. on a crop with complete vegetative cover, where application rates are sufficient to suppress transpiration.

Cloud cover had the effect of reducing losses by about one-third at the same vapor-pressure deficits although tests were too few to show an exact correlation.

Ariz. Agr. Expt. Sta., Tucson, Ariz.

30. Tovey, R., and Pair, C. H. A METHOD FOR MEASURING WATER INTAKE RATE INTO SOIL FOR SPRINKLER DESIGN. Sprinkler Irrig. Assoc. 1963 Open Tech. Conf. Proc.: 109-118. 1963.

A method for measuring the water intake rate into a soil for sprinkler design has been a need of the designer of sprinkler irrigation systems for many years.

The intake rate measuring equipment developed for the sprinkler design purposed consists of a trailer-mounted water recirculating unit which operates a sprinkler inside a circular shield. The shield permits the sprinkler to operate over an eighth of the area normally covered by a sprinkler operating outside the hood.

Intake rate measurement was made by bringing the test area to near field capacity, setting out 3 rows of pattern catch cans near the center of the area wetted by the sprinkler, and operating the sprinkler for a definite period of time while observing the intake of water in the soil at various places between cans. The area selected for measurement of the rate of application should be that where the water just disappears from the surface when the sprinkler nozzle has completed a revolution. Water caught in the pattern catch cans on either side or in the center of this area is measured, and knowing the time the sprinkler has been applying water, an intake rate can be calculated.

Results of 16 sprinkler-intake rate tests on 6 types of soil in the vicinity of Boise, Idaho were presented. Comparison of the sprinkler-intake rates with cylinder infiltrometer rates on the same sites indicated that the cylinder infiltrometer rates after 4 hours were higher and more variable than those measured by the sprinkler-intake rate measuring device.

SWCRD, ARS, USDA, Reno, Nev., 89507

31. Pair, C. H. USING SPRINKLER PATTERN DATA IN SYSTEM DESIGN. Sprinkler Irrig. Assoc. 1963 Open Tech. Conf. Proc.: 119-126. 1963.

An improved procedure was given for selecting a sprinkler head, spacing of sprinkler heads on the lateral pipeline, distance between lateral settings, and for determining the water application efficiency from sprinkler water distribution patterns. This procedure should greatly improve the design and performance of sprinkler irrigation systems.

SWCRD, ARS, USDA, Twin Falls, Idaho, 83301

32. Philip, J. R., and Farrell, D. A. GENERAL SOLUTION OF THE INFILTRATION-ADVANCE PROBLEM IN IRRIGATION HYDRAULICS. J. Geophysical Res. 69(4): 621-631. 1964.

The Lewis-Milne equation,

$$qt = cx + \int_0^T y(t - t_s)x'(t_s)\, dt_s$$

describes the advance of water down a border check when constant flow q per unit width is introduced at its head, c is the mean water depth, x is the distance of advance at time t, and the cumulative infiltration is y(t). The solution of (0) and the interdependence of x(t) and y(t) were studied. The results are of relevance to other methods of surface irrigation. (0) is valid only if x is a monotonic increasing function of t. Sufficient conditions are $y > 0$, $dy/dt > 0$, $d^2y/dt^2 < 0$. Normally, the physical restrictions on y are such that these conditions are realized and (0) is valid. The general solution of (0), "the infiltration-advance problem" is found by means of the Faltung theorem of the Laplace transformation. The solutions of (0) for the various common forms of y follow readily. The "Horton" solutions had been found previously by other methods. The new particular solutions are for the Kostiakov-Lewis equation and for the equation $y = St^{1/2} + At$, which was developed from a detailed physical study of infiltration. The solutions for this form of y were treated at some length. The power series and asymptotic expansion forms gave insight into behavior at small and large times. The relative importance of the parameters was shown to be c, S, and A at small times and A, S, and c at large times. Appropriate dimensionless forms simplify the graphical presentation of the solutions. The forms of x for various y(t) in the limit $c \to 0$ were presented. The inverse problem of deducing y from observed x and c was considered. The formal solution was given, and a simle method was developed in which known solutions of the infiltration-advance problem were used. With additional assumptions it applies also to the case where no data on c are available.

Commonwealth Sci. and Indus. Res. Organ., Canberra, Australia

33. Pair, C. H. USING SPRINKLER PATTERN DATA IN SYSTEM DESIGN. Sprinkler Irrig. Assoc. 1963 Open Tech. Conf. Proc.: 119-126. 1963.

The American Society of Agricultural Engineers' Committee on Sprinkler Irrigation is developing a standard procedure for determining water distribution patterns of sprinkler heads used in agriculture. When this procedure is developed and used by the manufacturers of sprinkler heads, data will be available which can be used to design better sprinkler systems. Using the water distribution pattern test information in sprinkler system design would give an added incentive for testing and publishing the data as well as replacing the sprinkler selection method presently used in sprinkler design with a method having an engineering basis.

The method now used for selecting a sprinkler system design assumes that the water application rate of a sprinkler lateral varies with the distance of lateral move on the main pipeline. This is an erroneous assumption because from the standpoint of the intake rate of the soil, the maximum water application rate from one sprinkler lateral is a function only of the nozzle size, nozzle pressure, and sprinkler spacing on the lateral pipeline. Varying the distance of lateral move on the main pipeline has no effect on the application rate of a sprinkler, but does affect the total amount of water applied to a field with a given time of lateral set.

The maximum sprinkler application rate should not exceed the water intake rate of the soil on more than 5 - 10 percent of the area wetted from one sprinkler lateral. The minimum rate must exceed the evaporation rate from the soil. Within this range of rates the sprinkler system designer selects a sprinkler that will give good water distribution and an operation time satisfactory for the equipment and labor available.

Equipment and procedures are available for measuring the water intake rate of the soil for sprinkler design.

SWCRD, ARS, USDA, Twin Falls, Idaho, 83301

34. Gray, A. S. PERMANENT AND SOLID SPRINKLER SYSTEMS: FOR IRRIGATION; FOR HEAT CONTROL; FOR FROST CONTROL. Irrig. Engin. and Maintenance 14(1): 12-13. 1964.

The value and use of sprinkler irrigation systems for heat control, frost control, and irrigation were given.

Natl. Rain Bird Sales Engin. Corp., Azusa, Calif.

35. Shull, H. LABOR REQUIREMENT FOR SPRINKLER IRRIGATION OF CORN. Trans. ASAE 6 (3): 251-253, 256. 1963.

A 3-year study of the labor required to sprinkler irrigate corn was conducted. All phases of the operation must be considered if the total labor required to sprinkler irrigate corn is to be kept to a minimum. The following principles should be followed to minimize the labor required:

1. Develop an operating plan that will keep all workmen productively employed at all times.
2. Equalize the work load for the workmen.
3. Be sure each workman knows exactly what he should do and how he should proceed with his work in the field.
4. Use lateral moving methods that require only one workman whenever possible.
5. Place lateral lines parallel to corn rows on level terrain.
6. Maintain uniform field boundaries. Shortening and lengthening laterial lines to follow non-uniform field boundaries increases the labor requirement.

The total labor required to operate the sprinkler system in corn was much lower after the detailed plan was put in operation. A total of 1.51 man-hours per acre per irrigation was required during the third year of the study, as contrasted with 2.64 man-hours per acre irrigation during the preceding year.

SWCRD, ARS, USDA, Brawley, Calif., 92227

36. Reineke, E. THE MECHANICS OF FERTILIZING THRU SPRINKLERS. Sprinkler Irrig. Assoc. 1963 Open Tech. Conf. Proc.: 63-65. 1963.

Only recently has fertilizer injection become an economical segment of irrigation. A major factor in this phase of improved fertilization is the availability of almost every conceivable type of fertilizer, nutrient, fungicide, or weed killer in a liquid form.

Inducing these foreign materials into the irrigation line can be justified because:

1. Injection feeding is virtually a "no-labor cost" item, other than perhaps an hour or two to check out the equipment each time it is used.
2. Split or continuous feeding provides a more efficient, lush crop.
3. Injection of chemicals into the sprinkler system provides a multiple use for a single capital investment.
4. Uniform distribution is available, or at least as uniform as the water application in the sprinkler system.
5. Application equipment is becoming economical, highly functional, and efficient. For multiple crop fertilizer application, the general practice is to inject the fertilizer directly into the lateral line covering the particular crop involved.

Methods of injecting solutions into pressure lines are:

1. A low capacity pump can be used with pressure slightly greater than the pressure in the line. This pump draws directly from the source of fertilizer in solution. The injection is continued until the source is depleted. A float switch can be used to shut off the fertilizer pump when it has all been applied.
2. Equipment involving the venturi principle can be used for injecting a calculated quantity of material from the source tank. The venturi apparatus

is installed in the mainline or sprinkler line. The fertilizer is drawn into the venturi and injected into the pressure line.

3. If a single source tank is used, it is often far more economical to use a concentrated fertilizer solution and accurately meter the solution into the sprinkler system to properly lower the concentration.

The corrosive action of the materials injected, although not necessarily of serious importance, must be considered in order to have a minimum of corrosive action on the metals involved. It is good practice to apply the fertilizers during the middle of any irrigation period. A positive procedure for flushing at the end of each operation should maintain the equipment in good operating condition.

When the source of water is a domestic supply, the most serious of all engineering considerations in designing fertilizer injection equipment into a sprinkler system is that of the possibility of contamination of potable water supply from back-siphonage. Any fertilizer injection system should not be installed without complete and adequate back-flow protection installed upstream of the injection device. Complete and adequate protection would consist of either an air gap and a pump operating out a tank, or a mechanical device, which is a pressure vacuum breaker installed in the line between the last potable use of the water and the injection equipment. Quite obviously, no water should be drawn from any portion of the system downstream of the injection device for domestic purposes.

Febco, Inc., Sun Valley, Calif.

37. Davis, J. R., and Hart, W. E. EFFICIENCY FACTORS IN SPRINKLER SYSTEM DESIGN. Sprinkler Irrig. Assoc. 1963 Open Tech. Conf. Proc.: 15-30. 1963.

Extreme scarcity of good data prevent an accurate determination of sprinkler system losses and an evaluation of the influencing factors. Lack of economic and agronomic interactions also deter the development of criteria upon which to base satisfactory designs.

Sprinkler system losses in view of available knowledge were discussed and suggestions for the design and improvement of such systems were presented. A summary of tentative possible system losses was presented in the table.

Table

Summary of Possible Sprinkler

System Losses

	Probable Maximum Losses		
	Permanent system small sprinklers	Portable system medium sprinklers	Large portable sprinklers
Pipe drainage	0%	2%	*0.5%
Outside-area losses	2	2	1
Field roads	0	0	3
Evaporation and drift	15	10	5
Interception	0	0	0
Distribution	10	20	30
Representative efficiency subject to improvements	75%	69%	64%

* Represents one
shut-down per lateral position

The greatest losses were due to poor water distribution and spray evaporation and drift. Reductions of both losses can be affected by closer sprinkler and lateral spacing and solid-set operation; such design could improve sprinkler system efficiency by 15 percent. Operation at night to reduce evaporation losses would also add up to 5 or 10 percent of system efficiency. Longer sets also tend to improve distribution.

System efficiency should infer not only water application efficiency but also efficient use of all labor, power, and fixed cost investments. The designer must determine the optimum combination of all these resources to effect a truly good design.

Stanford Res. Inst., Stanford, Calif.

38. Shahroody, A. M., and Davis, J. R. EFFICIENCY OF PUMPING FROM SMALL CIRCULAR SUMPS. J. Irrig. and Drain. Div., ASCE 90 (IR I): 1-8. Mar. 1964.

Recent emphasis on the recovery of irrigation tailwater in the United States has resulted in an increased use of pumped sumps as an integral part of irrigation systems. Sumps are also widely used in agricultural drainage systems and in many municipal and industrial supply and disposal systems.

Efficiency and minimum safe submergence of a 4-in. vertical turbine tail-water recovery pump in a circular pump were affected by side clearance and inflow velocity, but not by bottom clearance. Highest pump efficiency was attained in laboratory tests with a bottom clearance of either 0.5 D, D, or 2 D; a side clearance of 2 D or greater; and an inflow velocity of 1 f.p.s. where D represents the inside of the suction bell, in inches. Minimum safe submergence of approximately 9 D was required to avoid vortex formation; however, lowest values of minimum safe submergence were observed at small side clearances. Reductions in normal pump efficiency as a result of reduced side clearance or increase inflow velocity were most pronounced at the low rate at which peak efficiency was normally attained. Such reductions averaged approximately 2 percent, with a maximum loss in efficiency of 4.6 percent.

Stanford Res. Inst., South Pasadena, Calif.

39. Vittum, M. T., Alderfer, R. B., Janes, B. E., Reynolds, C. W., and Struchtmeyer, R. A. CROP RESPONSE TO IRRIGATION IN THE NORTHEAST. N.Y. State Agr. Expt. Sta. (Geneva) B. 800 (Northeast Region. Res. P.) 66 pp. 1963.

The development of light weight aluminum pipe and suitable pumps during and immediately after the war reduced equipment cost so that growers could consider irrigating many additional crops and acres in the Northeast.

Before this equipment could be used profitably, a number of problems had to be solved. To answer these problems, workers in several State Experiment Stations started irrigation research between 1948 and 1954.

To coordinate and stimulate this research, Directors of the Experiment Stations in the 12 Northeastern States, established a Regional Technical Committee for Irrigation in 1955. This committee formulated a regional research project covering a wide range of problems dealing with irrigation. By coordinating and pooling the efforts of many different workers in locations with varying climate and soils, it was possible in a few years to obtain the needed information.

The experimental procedures used in these trials were presented along with data for snap beans, lima beans, cabbage, potatoes, sweet corn, tomatoes, and forage crops from the different states. Many of the questions asked about irrigation in the Northeast were answered.

Tables.

N.Y. State Agr. Expt. Sta., Geneva, N.Y.

40. Yao, A. Y. M., and Shaw, R. H. EFFECT OF PLANT POPULATION AND PLANTING PATTERN OF CORN ON WATER USE AND YIELD. Agron. J. 56: 147-152. 1964.

Water use by corn plants under different plant populations and planting patterns was measured at Ames, Iowa, to study the possibility of increasing yield and increasing the efficiency of water use.

In 1960, the design of the experiment was a randomized complete block with 12 treatmens in factorial arrangement. The treatments were: 2 populations--14,000 plants and 28,000 plants per acre; 3 row spacings--21-, 32-, and 42-inch rows; and 2 row directions--E-W and N-S. In 1961 and 1962, the design was a split plot with eight treatments. The treatments were modified by adding irrigated and nonirrigated plots to the experiment and omitting the 32-inch row spacing and the N-S row directions.

In 1960, a high soil moisture content was maintained on all treatments by sprinkler irrigation. In 1961 and 1962, the irrigated plots were maintained at a high soil moisture level by flood type irrigation, while, on the natural plots, no water, other than rainfall, was added. Soil moisture was measured by using a neutron meter.

Early season water use for all treatments was about the same. Differences in water use between treatments were observed as the season progressed, especially when the 21-inch planting was compared with other treatments. For the same spacing, double plantings used more water than single plantings. Narrower row spacings used less water than wider row spacings. In 1960, Duncan's multiple range test showed that water use for the 42-inch E-W double planting was significantly more than for other spacings. The 21-inch single planting used significantly less water than any other treatment. In 1961, the 21-inch spacings used considerably less water than the 42-inch spacings, and double plantings used significantly more water than single plantings. Water losses from the sampling positions within treatments were significantly different for both the 21-inch and 42-inch spacings. The difference between different sampling positions for the 21-inch and the 42-inch spacings was largely attributed to the surface 9-inches of soil.

The efficiency of water use in 1960 was highest on the 21-inch double planting, with 571 pounds per acre per inch (p.a.i.) of water. The lowest efficiency was on the 42-inch single E-W row, with only 414 pounds p.a.i. of water. In 1961, for a different time period, the 21-inch single unirrigated planting had the highest efficency, with 694 pounds p.a.i. of water. The 42-inch single irrigated planting was the lowest, with 577 pounds p.a.i. of water. In 1962, the efficiency of water use was the highest on both 21-inch single planting unirrigated treatment, with 560 pounds p.a.i. of water. The lowest was with the 42-inch double planting, irrigated treatment with only 420 pounds p.a.i. of water. Corn yield in 1960 was significantly different for both spacings and populations. The 21-inch spacing yielded significantly more than the 32-inch and 42-inch spacings. There was no significant difference between the 32-inch and the 42-inch spacings and no difference between E-W and N-S rows. In 1961, both spacings and populations showed highly significant yield differences. In 1962, yield differences on the spacings were highly significant, but differences due to populations were significant only at the 5 percent level.

Res. Meteorologist, Foreign Area Sta., Off. Climatology, U.S. Weather Bur., Suitland, Md.

41. Bennett, O. L., Doss, B. D., Ashley, D. A., Kilmer, V. J., and Richardson, E. C. EFFECT OF SOIL MOISTURE REGIME ON YIELD, NUTRIENT CONTENT, AND EVAPOTRANSPIRATION FOR THREE ANNUAL FORAGE SPECIES. Agron. J. 56: 195-198. 1964.

Water-use of Sart sorghum and the yield, nitrogen content, and potassium content of Sart sorghum, Starr millet, and Sweet sudangrass grown at three soil moisture regimes were determined on a Greenville fsl in 1956-58, at Thorsby, Ala. Two plantings of each species were made each year to fully utilize the growing season. Moisture regimes were as follows: M_1 received rainfall only, and M_2 and M_3 received supplemental irrigation when 65 and 30 percent, respectively of the available soil moisture was used from the surface 2 feet of soil. All plots were fertilized uniformly with 1 ton of dolomitic lime, 400 pounds of N, 88 pounds of P, and 332 pounds of K per acre annually.

Yields of each species increased as available soil moisture increased, with Sart sorghum producing the highest yields of the three species at all three moisture regimes. Three-year average yields of dry matter for sudangrass, Starr millet, and Sart sorghum were as follows: M_1=4.0, 6.0, and 9.1 tons per acre; M_2=5.3, 8.6, and 12.9 tons per acre; M_3=6.1, 10.6, and 13.8 tons per acre, respectively. The maximum green weight yields, based on the 3-year average weights, were 25.3, 49.1, and 50.0 tons per acre on sudangrass, Starr millet, and Sart sorghum, respectively, at the M_3 soil moisture regime. Sart sorghum produced 46.9 tons per acre at the M_2 regime.

In general, percent of nitrogen and potassium in the plants decreased with increasing soil moisture, but since irrigation increased yields, total uptake was usually higher with irrigation. Total potassium uptake by millet in the aboveground portion of plants at the high soil moisture regime exceeded the amount applied to the soil (initial potassium content of the soil was high). Potassium recovery of the amounts applied varied from 55 percent with sudangrass (M_1) to a high of 143 percent with Starr millet (M_3). From 40 to 93 percent of the amount of applied nitrogen was found in the aboveground portion of the plants, depending upon species and soil moisture regime. Starr millet removed more total nitrogen and potassium from the soil than did either sudangrass or Sart sorghum.

Water was used by the plants in proportion to the amounts available for evapotranspiration. Evapotranspiration rates were higher for the first planting than for the second, with daily rates for M_3, M_2, and M_1, respectively, being 0.22, 0.20, and 0.17 inch per day in July, and 0.16, 0.12, and 0.10 inch per day in September.

SWCRD, ARS, USDA, Thorsby, Ala., 35171

42. Lorenz, R. J., and Rogler, G. A. EFFECT OF ROW SPACING AND NITROGEN FERTILIZER ON PRODUCTION OF IRRIGATED RUSSIAN WILDRYE (ELYMUS JUNCEUS FISCH.). II. RELATIVE CROWN AND ROOT DEVELOPMENT. Agron. J. 56(1): 7-10. 1964.

Differences in vigor and productivity of two adjacent plantings of irrigated Russian wildrye led to excavation and comparison of their root systems. A heavier root system was found under a 36-inch row spacing than under a 9-inch row spacing. Roots were found to the 8-foot depth under both row spacings. Nearly 60 percent of the total roots measured were found in the top foot of soil in both cases.

A hydraulic soil probe was used to sample an irrigated Russian wildrye forage production study area for root development and distribution after 4 years of forage data had been collected. Three replications of plots receiving N at 0, 100, 200, and 400 lbs./A. annually at row spacings of 6, 18, and 36 inches were sampled to a depth of 4 feet.

Total root production was greatest under the plots seeded in 6-inch rows; however, the concentration of roots directly under the row was greater at the wider row spacings. Root concentration decreased with increased distance of sampling from the center of the row. Although root weights 4.5 inches from the 36-inch row equaled those midway between the 6-inch rows, the root concentration midway between the 36-inch rows was much less than between the 6-inch rows.

Weight of roots increased with increasing N up to the 200-pound rate. Plots receiving 400 pounds of N usually produced less roots than those receiving 100 or 200 pounds but always more than those receiving no N. The greatest increase in root weight from the application of N occurred in the top foot of the profile, and the largest portion of this increase occurred directly under the row.

Increased row spacing increased the diameter of plant crowns but reduced the weight of crown material on an acre basis. Application of N increased crown diameter and weight per acre at all row spacings.

CRD, ARS, USDA, Mandan, N. Dak.

43. Lipps, R. C., and Fox, R. L. ROOT ACTIVITY OF SUB-IRRIGATED ALFALFA AS RELATED TO SOIL MOISTURE, TEMPERATURE, AND OXYGEN SUPPLY. Soil Sci. 97(1): 4-12. 1964.

Root activity of sub-irrigated alfalfa (water table at about 12 feet) was estimated, using radioactive phosphorus as a tracer. The tracer was placed in plots 3 X 3 feet at depths varying from 0 to almost 12 feet. Each plot contained thirty-six 1¼-inch auger holes, all of the same depth. Recovery of the tracer was measured by sampling forage at 1- to 2-week intervals.

Seasonal changes in soil moisture, temperature, and oxygen content in the soil atmosphere were determined. A sample of sub-irrigated alfalfa roots was removed from the soil for weighing.

Early in the spring, when soil moisture and temperature were most favorable in the surface soil, root activity was centered (88 percent of the total) in the upper 14 inches of soil. As the season advanced, moisture deficiency developed in the surface soil; concurrently, temperatures became more favorable in the well-watered capillary zone, 7 to 12 feet below the surface. Associated with these changes in environmental conditions was a shift in the center of root activity to the capillary zone. At the end of the growing season, 62 percent of the root activity was associated with the capillary zone below 7 feet.

U.S. Steel Corp., Salt Lake City, Utah.

Drainage

SEE ALSO 14, 15, 38, 132, 235, 238, 296.

44. Muckel, D. C. PROGRESS REPORT: NEW TECHNIQUES IN WATER MANAGEMENT. Agr. Engin. 45: 34-35. $0.50. 1964.

A report on the promising methods of drainage and water management involving new materials and new uses of materials, many of which will depend on mass acceptance to become economically feasible, was given.

Article is a condensation. Complete report for sale by ASAE, 420 Main St., St. Joseph Mich., 49085

45. Myers, V. I., Ussery, L. R., and Rippert, W. J. PHOTOGRAMMETRY FOR DETAILED DETECTION OF DRAINAGE AND SALINITY PROBLEMS. Trans. ASAE 6(4): 332-334. 1963.

Cotton was used as an indicator plant to relate spectral reflectance from cotton leaves, photographic tone contrast, and soil salinity (EC_e) in the 1 to 4-ft. profile. The levels of salinity fell into six groups which were used in the statistical studies and in correlations with photo tone contrasts. They were 0.50 to 0.65, 2.50 to 3.00, 5.50 to 5.60, 7.50 to 8.00, 10.25 to 11.00, and 11.30 to 13.00 electrical conductivity at the saturation extract (mmhos./cm.). The level of salinity significantly affected spectral reflectance from cotton leaves at wavelengths between 700 and 800 mu. Contrasting tone on aerial photos was closely associated with the six salinity ranges. Infrared film with an 89-A dark red filter sensitive in the 675 to 900 mu. range was used to photograph the study areas.

Sampling and photo interpretation procedures established will serve as criteria for widescale delineation of saline-high water table areas.

SWCRD, ARS, USDA, Weslaco, Tex., 78596

46. Bouwer, H., and van Schilfgaarde, J. SIMPLIFIED METHOD OF PREDICTING FALL OF WATER TABLE IN DRAINED LAND. Trans. ASAE 6(4): 288-291, 296. 1963.

Steady-state drainage solutions were analytically or graphically integrated to predict the rate of fall (or rise) of the water table midway between tile lines or ditches. The procedure assumed abrupt drainage of pore space. A factor (C) was introduced to account for the non-uniformity of flux per unit area of water table if the water table changed in shape during recession. The procedure was amenable to steady-state formulas or to graphical or tabular solutions obtained by analogs, models, numerical procedures, field experiments, or others.

Two integrated steady-state drainage equations (by Hooghoudt and by Toksoz and Kirkham) were compared with four solutions developed specifically for the falling water table. The transient formula by van Schilfgaarde accounted both for flow convergence and changing height of the flow system and showed good agreement with the two integrated equations, which also agreed mutually. The other three transient solutions had some inherent weaknesses and showed poor agreement.

U.S. Water Conserv. Lab., SWCRD, ARS, USDA, Tempe, Ariz., 85281

47. Sewell, J. I., and van Schilfgaarde, J. DIGITAL COMPUTER SOLUTIONS OF PARTIALLY UNSATURATED STEADY-STATE DRAINAGE AND SUBIRRIGATION PROBLEMS. Trans. ASAE 6(4): 292-296. 1963.

A computer program in parametric form was developed whereby a variety of drainage and subirrigation problems could be solved, taking into account flow above as well as below the water table. The program incorporated an estimate of maximum error of solution. The technique was more versatile than sand-tank models and more accurate than electric analogs.

The limitations of grid sizes inherent with electric analog techniques were not present in the computer-type solutions discussed. The only limitation related to grid size was the capacity of the computer itself. Any preset accuracy can be obtained within the limits of the error estimating technique.

The program permitted incorporation of any conductivity-tension relationship, and resulted in more realistic solutions than most other methods of analysis. The most serious limitation of the work reported was that all boundary conditions were specified in terms of constant potentials. Further work may remove this limitation. The authors felt that the computer technique was practical for conducting many phases of research in the flow of fluids through porous media and for solving families of drainage problems to obtain data for preparing handbooks or formulating design procedure.

U. Tenn., Knoxville, Tenn.

48. Dagan, G. SPACING OF DRAINS BY AN APPROXIMATE METHOD. J. Irrig. and Drain. Div., ASCE 90 (IR I): 41-66. Mar. 1964.

The steady seepage of rainfall through soil towards tile drains and drainage ditches was studied by an approximate method. The nonlinear condition for the velocity potential on the unknown free-surface was replaced by a linear condition in the drain and by horizontal flow assumptions in the remaining region. The linearized solution was derived by superposition of complex potentials; the horizontal flow was solved by the ellipse equation.

The combination of the two solutions permitted the derivation of formulas and curves for spacing of tile drains, at and below the water table, and ditches in both isotropic and nonisotropic soils. The solution was accurate when the free-surface slope was moderate. Numberical applications were presented.

Hydraul. Lab., Technion, Israel Inst. Tech., Haifi, Israel.

49. Kusse, A. D. NOMOGRAM FOR DETERMINING THE DIAMETER OF DRAINAGE TILES. Netherlands J. Agr. Sci. 12(2): 113-123. 1964.

With the aid of the nomogram described it was possible to determine quite simply all the factors which determine the design of a drainage system--diameters, geometric slope, the discharge intensity, drainage distance, and flow velocity--in their mutual relationship.

By these means it was possible, on a basis of the definite data, to choose for each drainage problem the solution, which provided the best answer to the requirements made on it. Although the nomogram was not primarily constructed for the calculation of compound drains, it was possible to determine the individual lengths for the various tile diameters by means of approximation.

Res. Dept., Koninklijke Nederlandsche Heidemaatschappij, Arnhem, Netherlands.

50. Wimberly, J. E. DESIGNING A FURROW IRRIGATION SYSTEM FOR SUGAR CANE. Agr. Engin. 45(3): 138-139. $0.50. 1964.

Production of sugar cane is impossible without good drainage. The present method consists of deeply sunk middles (usually 16 to 18 in. deep), clean quarter drains, good cross and lateral ditches, and adequate outlets.

Precision land grading has simplified the drainage problem and provided cuts of land adaptable to furrow irrigation.

Mathematical formulas that were developed to provide optimum stream size and time requirements for refilling moisture zone by furrow irrigation for growing sugar cane were given.

Complete report for sale by ASAE, 420 Main St., St. Joseph, Mich., 49085

51. Phillips, R. L. SURFACE DRAINAGE SYSTEMS FOR FARM LANDS (EASTERN UNITED STATES AND CANADA). Trans. ASAE 6(4): 313-317, 319. 1963.

This paper, the second of three papers, was on surface drainage for agricultural lands in the eastern United States and Canada. It is a report of the ASAE Surface Drainage Committee covering the principles of surface drainage and the different types of drainage systems. A number of drainage terms as set forth by the Committee was defined. The paper contains the following parts: Principles of surface drainage; surface drainage terms; and surface drainage systems in present use.

Surface drainage systems should: (1) Remove all surplus water from the field or area; (2) remove surplus water within a certain period of time; (3) be convenient to farm; (4) be easy to maintain; and (5) fit in with all phases of soil and water management.

Definitions of many of the terms used in surface drainage work as set forth by the Surface Drainage Committee on ASAE were given.

The five basic systems of surface drainage in common use today are: Bedding; random; land grading (parallel drains); interception (crossslope drains);

and diversion. They type to be used depends upon: The topography of the land; the crops to be grown; and the economics of each situation. Description, history, design requirements, and general observations were given for each of the systems.

SCS, USDA, Des Moines, Iowa.

52. Lyles, L., and Heilman, M. D. USING DRAINAGE DITCH SPOILBANKS IN LANDFORMING OPERATIONS IN TEXAS. J. Soil and Water Conserv. 19(2): 79-80. 1964.

A generally accepted standard for the use of spoilbank material in leveling cropland would be that such material have the characteristics needed for sustained high-level production of crops. The available phosphorous and salinity status of the 24 spoilbanks studied indicated that about 80 percent of the banks would not meet such a standard unless corrective measures were applied. These results suggest that spoilbanks should be tested for soluble salt content before material from them is spread over cropland.

The following suggestions for handling spoil material in landforming operations were given: (1) Place soil material in low areas, then cover it with topsoil or spread it thinly over the entire fill area; (2) leach it with excess irrigation water; and (3) apply fertilizers to correct its nutrient deficiencies.

SWCRD, ARS, USDA, Weslaco, Tex., 78596

53. Bornstein, J. GROUND WATER MOVEMENT IN POORLY DRAINED GLACIAL TILL SOIL. Trans. ASAE 7(1): 38-41, 45. 1964.

A drainage study was initiated on 24 acres of a 50-acre field of poorly drained Cabot 1 soil having a 5 to 7 percent slope. Twelve drainage treatments were installed consisting of diversion ditches placed at two depths (12 and 18 in.) and two spacings (200 and 400 ft.), alone and in combination with 4-in. diameter, perforated, bituminized fiber drains at two spacings (100 and 200 ft.). The shallower diversion ditches were designed to catch surface runoff alone, whereas the deeper ones were dug to the hardpan to intercept subsurface flow as well.

Two lines of piezometers were installed perpendicular to the slope. The data established directional flow of water and indicated that diversion ditches intercepted subsurface water to a limited extent. Below the 3-ft. depth, flow was primarily downward or parallel to the surface. This indicated that other drainage measures were necessary in this glacial till soil.

Diversion ditches were necessary to intercept surface flow as well as some subsurface water. These ditches were instrumented with flumes to measure their effectiveness. However, subsurface drains were needed to intercept and remove excess ground water in the hardpan. Such drains were installed where called for in the various drainage treatments. The effluent from these tiles will be measured by waterstage recorders placed in wells at the outlets. Additional piezometers are being installed in order to determine the effect of tile drains alone and in combination with diversion ditches on subsurface flow.

SWCRD, ARS, USDA, U. Vt. Burlington, Vt., 05401

54. Harris, W. S. ROW-CROP DRAINAGE IN THE ARKANSAS DELTA. Trans. ASAE 7(1): 64-66. 1964.

Row studies were conducted to determine the requirements for adequate drainage of row crops in the Arkansas delta.

The studies were conducted in 12 counties in the Mississippi river delta over a 4-year period (1959-62). The studies defined the requirements for the drainage of individual rows. These requirements can be applied to adjacent rows and to field surfaces.

U. Ark., Fayetteville, Ark.

55. Menz, J. A. THE ECONOMIC EVALUATION OF A DRAINAGE PROJECT. J. Soil and Water Conserv. 19(1): 12-14. 1964.

The problem of evaluating the benefits and costs of drainage projects is becoming increasingly important in the arid west, especially in those irrigated areas suffering from inadequate drainage. The evaluation procedure given could play a significant role in the formulation of such projects; it is well adapted for application under the Watershed Protection and Flood Prevention Act.

State Off., Planning of the Dept. Finance, Sacramento, Calif.

Evaluation of Flood Water Damage

SEE 2, 3, 5, 6, 7, 8, 9, 12, 231, 233, 234.

Storage and Conveyance

SEE ALSO 200, 228, 232, 252, 272, 279, 284, 285, 288, 289, 315.

56. Brehm, C. D. CATCHMENT AREA DEVELOPMENT FOR STOCKWATER. Land and Water Contact. 6(3): 14-15, 19. 1964.

An example was worked out for an area in South Dakota where one structure could be constructed in the center of a 640 acre range site in good condition. The carrying capacities of the range was figured at 50 head of cattle and 15,000 gallons of water would be needed for 30 days grazing. The average rainfall for the area averages 1 inch per month for the growing season. With this basic design figure, an impervious catchment area with the dimensions of 100 by 200 ft. could produce 15,000 gallons of runoff.

If the entire runoff is filtered and conveyed into a storage tank of about 10,000 gallons and the remaining 5,000 gallons stored in the stockwatering tank where it will be used, a full month's supply is available for a section of grazing land. The shaping of the catchment area can provide additional storage if needed.

This system of storing water is 100 percent efficient for all water in the storage tank. If the evaporation rate is high on the exposed water held in the watering tank or the extra water held in the catchment area, the newly developed chemical blocks can be used to put a film on the water surface and reduce this loss. If the tanks are full, the overflow to the catchment area wastes the excess water. Everything but the watering tank must be fenced to protect the area from all domestic or wild animals. Winter drainage of the system is a necessity.

The costs of the system were estimated as follows:

Cost of Sheeting (Plastic). .	$2,520.00	
Cost of Tape	36.00	
Shaping, earthwork.	200.00	
Spillway.	20.00	
10,000 gal. tank.	800.00	
Stock tank (10,500 gal.). . .	300.00	
Pipe, etc	150.00	
Installation.	100.00	
Fence 800' @ $.30	240.00	
Total	$4,366.00	for 640 Acres
		$6.82 per acre

This system of range stock watering facility compares very favorably with other systems because it eliminates some of the design problems or hazards that are common to earthwork construction. Some of the advantages of this system are:

1. Failure would not be hazardous to human or animal life, or to property.
2. The number of stockwatering facilities can be reduced because these can be placed where needed. Stockwater dams or dugouts must be placed where the runoff will be great enough to annually fill the storage area.
3. The runoff is positive and does not rely on hydrologic estimates of what may occur on the drainage area above the dam.
4. There are no problems of siltation. The water is clean and not muddied by silt.
5. Less actual area is dedicated to this system than for a dam or dugout.
6. Costs are favorable and life span comparable to any other system.
7. The facility can be modified if necessary.
8. Design, layout, and construction are simple and can be standardized.
9. There are no losses of animals breaking through ice covered ponds.
10. Maintenance is simple and inexpensive.

This system of catchment area development shows promise as a means of helping meet the needs for stockwater in the Great Plains.

SCS, USDA, Huron, S. Dak.

57. Funderburk, H. H., Jr., and Lawrence, J. M. ABSORPTION AND TRANSLOCATION OF RADIOACTIVE HERBICIDES IN SUBMERSED AND EMERSED AQUATIC WEEDS. Weed. Res. 3 (4): 304-311. 1963.

Absorption and translocation of labelled herbicides by a submersed weed, waterstargrass (*Heteranthera dubia* (Jacq.) MacM.) were studied. Autoradiographs showed that simazine (or the labelled carbon atom) and 2,4-D-butoxyethyl ester moved both from roots to shoots. Ametryne, prometryne, fenac, and 2,4-D (acid) moved to a slight extent from shoot to root, but no movement from root to shoot could be detected in the autoradiographs. However, counting data indicated that small amounts of these four compounds, not recorded on autoradiographs, may move from root to shoot. Radioassay did not detect diquat or paraquat movement to the roots or to the upper portions of the shoots, but the autoradiograph of one plant receiving a root application of paraquat showed slight movement into the lower portion of the stem.

Absorption and translocation of labelled herbicides by an emersed weed, alligatorweed (*Alternanthera philoxeroides* (Mart.) Griseb.), were also studied. Darkening of film indicated that relative mobility of root-applied herbicides was as follows: ametryne = fenac = prometryne = simazine > diquat = paraquat 2,4-D (acid) = 2,4-D-butoxyethyl ester. There was little movement of foliage-applied simazine, ametryne, and prometryne. There was slight downward movement of foliage-applied fenac, diquat, and paraquat, and considerable downward movement of 2,4-D (acid) and 2,4-D-butoxyethyl ester, which accumulated in the nodal regions of the stem.

Radiolabelled phosphorus moved in both directions in both plants and there was more movement in an upward direction in both species.

Auburn U., Agr. Expt. Sta., Auburn, Ala.

58. Seaman, D. E., and Porterfield, W. A. CONTROL OF AQUATIC WEEDS BY THE SNAIL *MARISA CORNUARIETIS*. Weeds. 12(2): 87-91. 1964.

Experiments were conducted in 200-gal. concrete tanks to evaluate a large freshwater snail, *Marisa cornuarietis*, as a biological aquatic weed control agent. Adult *Marisa* snails were collected from a canal near Miami, Fla. These snails are of South American origin and appear identical to those being used in Puerto Rico for biological control of schistosomiasis. The snails controlled *Ceratophyllum demersum*, *Najas guadalupensis*, and *Potamogeton illinoensis* completely and *Pistia stratiotes* and *Alternanthera philoxeroides* partially. *Eichhornia crassipes* was not completely eaten, but its growth and flowering were greatly retarded by the root-pruning action of the snails.

Marisa preferred submersed weeds to floating or emersed weeds, but the floating weed *Salvinia rotundifolia* was eaten nearly as readily as submersed weeds. Little damage was done by *Marisa* to 4- and 5-week-old rice plants, but younger rice was killed when the snails had no other source of food. A common snail-eating bird, *Cassidix mexicanus*, was found to be a predator of *Marisa* in Florida. Except for its possible deletarious effects in rice-growing areas, *Marisa* was regarded as very promising for control of aquatic weeds in confined bodies of water.

U. Calif., Davis, Calif.

BASIC SOIL SCIENCE

Soil Physics

SEE ALSO 25, 28, 29, 30, 32, 33, 40, 41, 43, 94, 119, 120, 128, 133, 135, 136, 149, 154, 171, 172, 173, 174, 175, 178, 181, 183, 215, 216, 318.

59. Bennett, O. L., Ashley, D. A., and Doss, B. D. METHODS OF REDUCING SOIL CRUSTING TO INCREASE COTTON SEEDLING EMERGENCE. Agron. J. 56: 162-165. 1964.

Three 9-day studies were conducted on a Greenville fsl to: (1) Evaluate methods of reducing soil crusting to increase seedling emergence of cotton; (2) determine the relationships among soil crusting, soil moisture content, and seedling emergence; and (3) test a simple method of determining relative crust strength under field conditions. Treatments included various methods of planting, the use of evaporation-suppressing agents, chemicals to increase moisture content of the soil surface over seed, and soil conditioners.

Soil crust-breaking strength measurements were made by determining the force required to pull a fishing line to the surface of the soil. Crust strength was reduced by increasing soil moisture content and by use of soil conditioners. Correlation ($P = .01$) was found between seedling emergence and crust strength, and between seedling emergence and moisture content of the surface 3 inches of soil.

An average of only 10.8 percent of the seedlings emerged from conventional planting, whereas 77.8 percent of the seedlings emerged when rows were covered with black plastic film. At least 50 percent emergence was obtained by using the following treatments: Absorption alumina; krilium; water emulsion asphalt; soil fracturing agent; and water emulsion vinyl resin. Altering geometry of soil surface by planting between ridges perpendicular to prevailing wind resulted in 35 percent seedling emergence.

SWCRD, ARS, USDA, Throsby, Ala., 35171

60. Ryaboklyach, V. A., Savitskaya, M. N., and Khomenko, A. D. THE EFFECT OF POLYMERS ON THE PHYSICAL PROPERTIES OF SOILS AND ON THE YIELD OF AGRICULTURAL CROPS. Soviet Soil Sci. 6: 589-598. June, 1963.

The major results in the development of techniques and in the study of the influence of some polymers on the macrostructure of the soil, the main agricultural-physical properties of sandy loam sod-podzolic and gray clay loam podzolized soils, and on the germination, growth and yield of corn and potatoes were reported. The authors concluded that:

1. Water solutions of PAA, HPAN, and CP-8 in amounts from 0.01-0.1 percent of soil weight were capable of increasing the water-stability, stabilizing the macrostructure, and improving some physical properties of the soils.
2. In field and pot experiments, there were no clearly-defined effects of polymers on the yield of corn and potatoes grown without fertilizers.
3. Additions of 0.01-0.05 percent of PAA, HPAN and CP-8 in solutions to these soils had a positive effect on the growth and yield of corn and potatoes in a number of cases when used with a complete mineral fertilizer.
4. The positive effect of additions of polymers on plants was frequently not directly associated with their aggregating effect on the soil and the content of nutrients in the polymers.
5. Investigations to find ways of improving plant nutrition conditions in strongly dispersed, little coherent, and saline soils by means of polymers should be continued.
6. To improve the effectiveness of polymers and further study their influence on soils and plants it was considered necessary to: (1) Increase the solubility of PAA in water; (2) prepare additional experimental batches of PAA; and (3) produce polymeric soil conditioners in powder form.

Scripta Technicia Inc., 1000 Vermont Ave., N.W., Washington, D.C., 20005

61. Lyles, L., and Woodruff, N. P. EFFECTS OF MOISTURE AND SOIL PACKERS ON CONSOLIDATION AND CLODDINESS OF SOIL. Trans. ASAE 6(4): 273-275. 1963.

The extent and magnitude of soil bulk densities obtainable with three commercial agricultural soil packers were investigated by varying the packer weight and number of passes over the soil surface. Chiseling, after packing, was performed at optimum moisture content for compaction on a sandy loam soil in the laboratory. Measurements of treatments were in terms of soil bulk density and clod yield. The effects of packing at moisture contents other than optimum were also studied.

None of the packers appreciably increased the soil bulk density. Multiple passes of a sprocket and a diamond packer increased clod yield some, but a V-wheel packer increased clods very little. Apparently, heavier type packers like those used in highway construction would be necessary to obtain fairly high densities with a single pass over the surface.

Both soil bulk density and moisture content greatly affected the quantity of clods produced. It was especially important that the soil be packed near optimum moisture content (OMC). Packing below 0.8 OMC produced fragile, unstable clods.

Bulk densities obtained with a 3-in. core sampler and those obtained with the Cornell soil penetrometer were compared.

SWCRD, ARS, USDA, Weslaco, Tex., 78596

62. Olsen, S. R., Watanabe, F. S., Clark, F. E., and Kemper, W. D. EFFECT OF HEXADECANOL ON EVAPORATION OF WATER FROM SOIL. Soil Sci. 97(1): 13-18. 1964.

Hexadecanol was added at three rates and four placements to a Weld 1 soil. Water was added to the soil until the moisture content was at the field capacity. Water lost by evaporation was measured gravimetrically for 10-day periods. This water-addition-evaporation cycle was continued for 14 months.

Hexadecanol suppressed the evaporation of water from soil. Water loss decreased 43 percent in a 10-day period. A surface placement was the most effective and the most enduring, remaining unchanged during a 14-month test period. The mechanism of this action differred in some respects from that observed for hexadecanol on a free-water surface. In soil, hexadecanol allowed the surface layer to dry and created a diffusion barrier to water loss by vapor transfer. With the best treatment, the surface $\frac{1}{4}$ inch of soil reached a moisture content of 3.9 percent, or equal to the air-dry state, in 3 days following irrigation, whereas the surface layer of the control soil still contained 21 percent moisture.

Hexadecanol also increased rate of water infiltration. Apparently this resulted from its action in increasing stability and size of aggregates.

SWCRD, ARS, USDA, Fort Collins, Colo., 80522

63. Aubertin, G. M., and Gorsline, G. W. EFFECT OF FATTY ALCOHOL ON EVAPORATION AND TRANSPIRATION. Agron. J. 56(1): 50-52. 1964.

A fatty alcohol mixture containing hexadecanol and octadecanol was applied to the soil in which maize was grown in the greenhouse to determine if this fatty alcohol mixture could be used to decrease evapotranspiration. The applications reduced total water usage, evaporation, and plant growth. Transpiration was reduced by the addition of the first increment of fatty alcohol, due to decreased plant growth, but no further changes occurred with additional increments of fatty alcohol. Total water usage per gram of oven dry plant material actually increased with the addition of fatty alcohol to the soil.

Data from experiment A indicated that all treatments required the same amount of transpiration water to produce one gram of oven dry material. The greater total water usage per gram of dry matter produced was due to the fact that the amount of transpiring agent (dry matter) was decreased by the fatty alcohol proportionately more than the amount of water lost by evaporation. In experiment B, since the same amount of fatty alcohol per pot was present in both the 4 percent layer and the 1 percent total treatments, it was suggested that the marked differences noted may have been caused by forcing the roots of the plants in the 1 percent total treatment to feed entirely within the treated zone.

Pa. State U., University Park, Pa.

64. Green, R. E., Hanks, R. J., and Larson, W. E. ESTIMATES OF FIELD INFILTRATION BY NUMERICAL SOLUTION OF THE MOISTURE FLOW EQUATION. Soil Sci. Soc. Amer. Proc. 28(1): 15-19. 1964.

The numerical procedure of Hanks and Bowers was used to solve the moisture flow equation for boundary conditions corresponding approximately to those existing for infiltration into a field soil. Water diffusivity and retention data, necessary for theory calculations of infiltration, were measured on field cores by the outflow method. Infiltration estimates were obtained for a simulated two-horizon soil with three nonuniform antecedent moisture profiles.

Calculated infiltration rates were in good agreement with field rates measured with a sprinkling infiltrometer. Although not considered a substitute for field measurement, the numerical procedure appeared to be a useful means of supplementing field measurement data by providing estimates of infiltration for simulated conditions of practical interest which were difficult to evaluate in the field.

Hawaii Agr. Expt. Sta., Maui, Hawaii

65. Gardner, W. R. RELATION OF ROOT DISTRIBUTION TO WATER UPTAKE AND AVAILABILITY. Agron. J. 56(1): 41-45. 1964.

A mathematical theory describing water uptake by nonuniform root systems and other factors was developed. The relative distribution of roots with depth and the water retaining and transmitting properties of the soil determine the main features of the water uptake pattern. Other factors such as the total number of roots were relatively unimportant. Good agreement was obtained between the theory and an actual uptake pattern for sorghum.

U.S. Salinity Lab., SWCRD, ARS, USDA, Riverside, Calif., 92502

66. Namken, L. N. THE INFLUENCE OF CROP ENVIRONMENT ON THE INTERNAL WATER BALANCE OF COTTON. Soil Sci. Soc. Amer. Proc. 28(1): 12-15. 1964.

The relative turgidity of cotton plants subjected to three soil moisture levels was related to soil moisture content, air temperature, pan evaporation, vapor pressure deficity, and air movement. A multiple regression equation that contained only those variables significant at the 1 percent level of probability was developed. The influences of vapor pressure deficit and air movement were not significant at the 1 percent level. Soil moisture, ambient temperature, and pan evaporation accounted for 87.5 percent of the variation in the relative turgidity of cotton leaves. Soil moisture alone accounted for 70.9 percent of the variation with a reduction to 44.3 percent upon discounting the effects of ambient temperature and pan evaporation. Ambient temperature and pan evaporation accounted for 43.1 percent of the variation with a reduction to 16.5 percent upon discounting the effect of soil moisture.

SWCRD, ARS, USDA, Weslaco, Tex., 78596

67. Ziemer, R. R. SUMMER EVAPOTRANSPIRATION TRENDS AS RELATED TO TIME AFTER LOGGING OF FORESTS IN SIERRA NEVADA. J. Geophysical Res. 69(4): 615-620. 1964.

The quantity of summer soil moisture lost from logged forest openings was related to the length of time since the creation of the opening, in the subalpine forest zone of the Sierra Nevada west side, near the Central Sierra Snow Laboratory, Calif., at an elevation of 6,000 to 7,000 feet.

Soil moisture depletion was measured in forest openings which were created in 1959, 1955, 1950, and 1948, and in the forest surrounding these openings. Soil moisture was uniformly near field capacity in all plots in early June. Later soil moisture was lost most rapidly from the forested parts of the plots and at progressively slower rates toward the center of the openings. The rate of moisture loss was greatest in early summer and then decreased as the availability of moisture decreased. Maximum soil moisture depletion occurred in early September, nearly all the available moisture being depleted from the forest. The quantity of residual soil moisture increased toward the center of the openings. At the period of maximum soil moisture depletion, openings 1 year old were found to have 6.9 inches more soil moisture per 4 feet of soil than the surrounding forest had, which is an expression of the quantity of moisture saved as a result of the logging operation. In openings 5 years old, the saving has decreased to 2.9 inches, after 10 years to 1.2 inches, and after 12 years to 0.7 inch. A projection of the regression indicates that the moisture saving at maximum depletion will become negligible 16 years after cutting.

Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif.

68. Bryan, B. B., and Brown, D. A. FIELD MEASUREMENT OF EVAPOTRANSPIRATION OF COTTON. Trans. ASAE, 6(3): 217-219, 222. 1963.

Field measurements of evapotranspiration rates were made for cotton growing on Grenada sil and Sharkey c soils in Arkansas. The authors concluded that:

1. The maximum evapotranspiration rate of cotton growing on Grenada sil was 0.23 in. per day and occurred during the period of maximum plant fruiting.
2. Moisture removal occurred at least as deep as 18 in. in the root zone of the plant; however, about 75 percent of the moisture removal occurred in the 0 to 6-in. soil depth.
3. Evapotranspiration rates of cotton growing on Sharkey c soil was as high as 0.54 in. per day for short periods of time during the maximum fruiting period of the plant.
4. Moisture depletion of Sharkey c soil on which cotton was growing occurred at least as deep as 24 in.

U. Ark., Fayetteville, Ark.

69. Hewlett, J. D., Douglass, J. E., and Clutter, J. L. INSTRUMENTAL AND SOIL MOISTURE VARIANCE USING THE NEUTRON-SCATTERING METHOD. Soil Sci. 97(1): 19-24. 1964.

The variation of soil moisture estimates determined by the neutron-scattering method was examined in theory and related to field data from two research areas. A statistical model was developed to account for error. Instrument and timing errors were shown to contribute insignificantly to the standard error of estimate in sampling studies. Furthermore, their contribution to estimates of moisture change with time was, for all practical purposes, negligible, as long as the timing interval used at each observation exceeded 30 seconds. In most studies, even shorter timing intervals were used safely.

Southeastern Forest Expt. Sta., FS, USDA, Asheville, N.C.

70. Ohmstede, W. D. NUMERICAL SOLUTION OF TRANSIENT FLOW OF WATER IN UNSATURATED SOIL WITH APPLICATIONS TO OUTFLOW FROM SOIL MOISTURE EXTRACTORS. J. Geophysical Res. 69(4): 633-642. 1964.

The results of a program of numerical analysis of nonlinear partial differential equations which described nonsteady soil moisture transfer were given. The results, when combined with experimental data, are intended for use in determining the soil moisture transfer characteristics of various types of soil.

The linear theory was significantly inaccurate in representing unsaturated transient flow of water in soils for finite perturbations. For step-function transient outflow experiments performed for determination of soil moisture transfer characteristics, the numerical solutions presented allow all data obtained from the experiments to be used in characterizing the soil water diffusivity over the full range of the step.

If there was a significant membrane impedance, the determination of the soil water diffusivity became much more complex. Because of the limited number of solutions presented, practical determinations of the diffusivity required that the membrane impedance effects be minimized. This can be done by increasing the soil slab thickness, by decreasing the pressure step size, and by working at high matric suctions. It was concluded that the effects of gravity on laboratory transient outflow experiments were negligible.

U.S. Army Electronics Res. and Develop. Activ., Fort Huachuca, Ariz.

71. Bouwer, H. MEASURING HORIZONTAL AND VERTICAL HYDRAULIC CONDUCTIVITY OF SOIL WITH THE DOUBLE-TUBE METHOD. Soil Sci. Soc. Amer. Proc. 28(1): 19-23. 1964.

Horizontal and vertical hydraulic conductivity, symbols K_h and K_v, respectively, of anisotropic soils in which the principal conductivity components are in the horizontal and vertical directions, can be measured with the double-tube method. The principle is based on manipulation of flow direction in the artificially saturated soil region below the auger hole. As with the original double-tube method, the presence of a water table is not required.

If the water levels in the inner and the outer tube differ, the streamlines in the resulting flow system below the auger hole have both horizontal and vertical portions. Thus, the hydraulic conductivity measured with the conventional double-tube method from this flow system on the basis of assumed isotropy, symbol K_{dt}, is some resultant of K_h and K_v. If the water levels in the inner and the outer tube are the same, the flow in the soil below the inner tube is, initially, vertically downward. Piezometers are used to measure the vertical hydraulic gradient and knowing the intake rate, K_v can be computed. By transformation to equivalent isotropic systems, the relationship between K_{dt}/K_v and K_h/K_v can be determined and expressed in the form of a graph. Thus, knowing K_{dt} and K_v, the conductivity K_h can be evaluated from that graph.

Laboratory studies on artificial anisotropic soil consisting of alternating 0.5-cm. layers of coarse and fine soil were performed to verify and exemplify the method.

U.S. Water Conserv. Lab., SWCRD, ARS, USDA, Tempe, Ariz., 85281

72. Williamson, R. E. THE EFFECT OF ROOT AERATION ON PLANT GROWTH. Soil Sci. Soc. Amer. Proc. 28(1): 86-90. 1964.

Rates of oxygen diffusion were measured in soil contained in 3-foot-cube lysimeters in field installations. Water tables were maintained by subsurface watering at 6- to 30-inch depths below the soil surface. Some lysimeters were sheltered from rain. Soybeans, cabbage, grain sorghum, sweet corn, and dwarf field corn were grown in these lysimeters.

The highest yields were obtained at oxygen diffusion rates of approximately 15 g. X 10^{-8} per $cm.^2$ per minute. The maximum yields were high in comparison with yields obtained in most field experiments. Oxygen diffusion rates at 6-inch water table depths were below 5 g. X 10^{-8} per $cm.^2$ per minute. Under these conditions of extremely poor aeration, yields of grain sorghum, soybeans, cabbage, sweet corn, and dwarf field corn were reduced 25, 35, 40, 65 and 75 percent respectively.

SWCRD, ARS, USDA, Raleigh, N.C., 27607

SEE ALSO 19, 25, 41, 52, 57, 91, 92, 93, 95, 97, 102, 103, 105, 117, 118, 119, 120, 121, 128, 144, 145, 146, 155, 157, 158, 159, 160, 163, 167, 168, 171, 178, 183, 214, 316, 317, 318.

73. Clark, J. S. SOME CATION-EXCHANGE PROPERTIES OF SOILS CONTAINING FREE OXIDES. Canad. J. Soil Sci. 44(2): 203-211. 1964.

Low CEC values were obtained for the B horizon of a Concretionary Brown soil from British Columbia and a Podzol from New Brunswick, when $CaCl_2$ was used to saturate the cation-exchange complex. Higher CEC's were obtained when $Ca(OAc)_2+CaCl_2$ was used and this showed that the soils had a large pH-dependent component of the CEC. Both soils had a high proportion of pH-dependent charge after the destruction of the soil organic matter. Extraction of free iron oxides increased the CEC of the inorganic exchange fractions and eliminated or decreased the pH-dependent component of the CEC.

Relatively large amounts of iron and aluminum were removed from the soils by the free oxide extraction procedure. These results suggest that the fixation of aluminum and iron was responsible for the low permanent charge values obtained for the soils. The precipitation of the fixed Al and Fe as $Al(OH)_3$ when the soils were treated with base or extracted with buffered salt solutions released exchange sites and gave an effect equivalent to the release of exchangeable H so that the soils had a large pH-dependent component of the CEC.

Soil Res. Inst., Canada Dept. Agr., Ottawa, Ontario, Canada

74. Thompson, S. O., Chesters, G., and Engelbert, L. E. COMPARATIVE PROPERTIES OF PLANT LIGNINS AND HUMIC MATERIALS OF SOILS: I. YIELDS AND CATION EXCHANGE PROPERTIES OF PLANT LIGNINS ISOLATED BY DIFFERENT TECHNIQUES. Soil Sci. Soc. Amer. Proc. 28(1): 65-68. 1964.

Yields and cation-exchange capacities for Ca and Cu were determined for lignin samples isolated with 72 percent H_2SO_4, HCl-H_3PO_4 mixture, 5 percent aqueous NaOH, and 1,4-dioxane. Yields varied with extractant in the order: Acid- > dioxane- > NaOH-extracted lignins. For equal time, a higher yield of dioxane pine lignin was obtained by fractional than by a one-step extraction. In most cases, cation-exchange capacities varied with lignin source and with method of extraction as follows: (1) Straw liginins > wood lignins; and (2) alkali- > dioxane- > acid- extracted lignins.

Lignins isolated by fractional extraction with dioxane showed the later fractions to have higher exchange capacities. Values for the one-step extracted isolates were intermediate with respect to the high and low values of the fractionally isolated samples. Lignin, like soil organic matter, had higher adsorptive capacity for Cu than for Ca, and the adsorptive capacity was pH dependent. All samples examined for the effect of pH on Cu adsorption showed the same relative change in adsorption for a given change in solution acidity.

U. Wis., Madison, Wis.

75. Chapin, J. S., Fisher, F. L., and Caldwell, A. G. EFFECT OF FERTILIZERS ON THE CONDUCTIVITY OF SATURATED SOIL EXTRACTS. Soil Sci. Soc. Amer. Proc. 28(1): 90-92. 1964.

Varying concentrations of fertilizers were mixed with Yahola fsl, Norwood sl, and Miller c. Conductivity of the saturation extract was determined using a Wheatstone bridge. There was a marked difference in the conductivity caused by the different fertilizer materials. The fertilizers used were arranged in the following order of increasing effect (based on weight per unit of soil) on conductivity of the saturation extract; Urea; ordinary superphosphate; concentrated superphosphate; phosphoric acid; monoammonium phosphate; diamonnium phosphate; potassium sulfate; ammonium nitrate; and potassium chloride. Urea was unique in that the conductivity of the saturated extract increased with time of incubation.

Tex. Agr. Expt. Sta., College Station, Tex.

76. Pratt, P. F., and Grover, B. L. MONOVALENT-DIVALENT CATION-EXCHANGE EQUILIBRIA IN SOILS IN RELATION TO ORGANIC MATTER AND TYPE OF CLAY. Soil Sci. Soc. Amer. Proc. 28(1): 32-35. 1964.

Cation-exchange equilibria at pH 7 were measured using ion pairs of Na-Ca, Li-Ca, and Li-Mg on each of 10 soils. Data on Li-Mg and Na-Ca ion pairs were nearly the same and data on Li-Ca were highly correlated with exchange equilibria data on both Na-Ca and Li-Mg. Two soils containing largely amorphous clay minerals showed a higher preference for Li than soils containing dominantly crystalline clay minerals.

Destruction of the organic matter in two soils increased the ratio of Na to Ca adsorption to a much greater extent than would be predicted by the decrease in measured surface charge density. At a sodium-adsorption ratio (SAR) of 100 (mmole per liter) $^{1/2}$, organic-matter free soils containing dominantly montmorillonite and illite clays had ratios of Na to Ca adsorption of 1.66 to 1.94 (excluding one soil, 1.66 to 1.78). Two soils with dominantly amorphous minerals had ratios of 0.92 and 1.10, and one soil with a mixture of kaolinite, illite, and amorphous clays had a ratio of 1.35.

U. Calif. Citrus Res. Cent., Agr. Expt. Sta., Riverside, Calif.

77. Weed, S. B., and Leonard, R. A. A COMPARISON OF Mg^{2+}, Ca^{2+}, and Sr^{2+} AS EXCHANGE IONS FOR MINERALOGICAL STUDIES OF CLAYS. Soil Sci. Soc. Amer. Proc. 28(1): 58-62. 1964.

Strontium-, Ca^{2+}, and Mg^{2+}-saturated clay minerals were studied with respect to X-ray diffraction, differential thermal analysis, cation exchange capacity, and glycerol adsorption. In general, 3-layer clay minerals saturated with Sr^{2+} lost interlayer water at lower temperatures and at higher vapor pressures than did Mg^{2+}-clays; Ca^{2+}-clays were intermediate. A clay mineral-ion-saturation interaction was apparent. Calcium- and Sr^{2+}-saturation of clays yielded similar values for cation exchange capacity. Strontium-saturated 3-layer clays retained more glycerol than did clays saturated with Ca^{2+}. Expansion of vermiculite with glycerol and ethylene glycol was dependent on cation saturation and lattice charge. Strontium-saturated vermiculites expanded to near 16Å. more readily than did Mg^{2+}-clays, and Ca^{2+}-clays were intermediate. Vermiculties with high lattice charge expanded less readily than did vermiculties with relatively low lattice charge.

Strontium can satisfactorily substitute for Ca^{2+} and Mg^{2+} in routine mineralogical studies of clays though special care may be needed to control relative humidity. Additional information regarding lattice charge of 3-layer clays may be obtained by using several divalent ion saturations.

N.C. Agr. Expt. Sta., Raleigh, N.C.

78. Taylor, A. W., Gurney, E. L., and Moreno, E. C. PRECIPITATION OF PHOSPHATE FROM CALCIUM PHOSPHATE SOLUTIONS BY IRON OXIDE AND ALUMINUM HYDROXIDE. Soil Sci. Soc. Amer. Proc. 28(1): 49-52. 1964.

Aluminum hydroxide is the principal reagent in the precipitation of phosphate from fertilizers in acid soils. Iron oxide is much less reactive unless it is very finely divided. In cold phosphate solutions, clay minerals are stable in comparison with hydrated iron and aluminum oxides. The amounts of dicalcium phosphate, calcium aluminum phosphate, and amorphous aluminum phosphate that are precipitated when gibbsite dissolves in potassium-free acidic calcium phosphate solutions depend upon the rate of dilution of the solution. Amorphous ferric phosphate and calcium ferric phosphate are formed during the dissolution of goethite, but, unless the soil contains a large amount of reactive iron oxide, most of the phosphate will be precipitated as aluminum compounds.

TVA, Wilson Dam, Ala.

79. MacLean, A. A. THE EVALUATION OF THE RESIDUAL EFFECT OF FERTILIZER IN LONG-TERM FERTILITY PLOTS: II. PHOSPHORUS. Canad. J. Soil Sci. 44(2): 223-227. 1964.

Long-term annual applications of fertilizer phosphorus to an acid sandy loam podzol resulted in marked increases in total phosphorus content of the surface soil. However, downward movement was limited as no increase occurred below 9 in. The relationship between total phosphorus content of the profile and sodium bicarbonate-soluble phosphorus ($r = 0.93$) was significant at the 1 percent level. Phosphate retention capacity of the surface soil was not influenced by fertilizer or manurial treatment and increases in percentage phosphorus saturation were relatively small.

Under conditions of intensive cropping in the greenhouse (12 crops), residual phosphorus was highly effective in supplying crop requirements. However, the results suggest that fertilizer phosphorus may be beneficial during the establishment period. The relationship between phosphorus uptake on the no P series in the greenhouse and levels of sodium bicarbonate-soluble phosphorus ($r = 0.88$) emphasizes the value of this method in estimating phosphorus availability in soils.

Res. Sta., Canada Dept. Agr., Fredericton, New Brunswick, Canada.

80. Sengupta, M. B., and Cornfield, A. H. EFFECT OF CALCIUM CARBONATE CONTENT AND SOLUBLE PHOSPHATE ON THE MINERALISATION OF ORGANIC PHOSPHORUS IN CALCAREOUS SOIL. Indian Soc. Soil Sci. J. 11(4): 373-378. 1964.

Some incubation experiments were made to assess the extent to which mineralization of organic phosphorus in calcareous soils was influenced by the amount of calcium carbonate present. Release of sodium bicarbonate extractable phosphate due to mineralization during incubation varied inversely with the amount of calcium carbonate present.

This trend in organic phosphorus mineralization was also observed in an experiment when two soils, varying in their calcium carbonate content, were compared periodically for the amount of organic phosphorus remaining in the soils during incubation. Addition of soluble inorganic phosphate increased the mineralization of added nucleic acid phosphorus. Mineralization of phytin phosphorus in a calcareous soil was less than that of nucleic acid phosphorus.

Bot. Substation, Pusa, Darbhanga, Bihar, India

81. Lehr, J. R., Frazier, A. W., and Smith, J. P. A NEW CALCIUM ALUMINUM PHOSPHATE, $CaAlH(PO_4)_2.6H_2O$. Soil Sci. Soc. Amer. Proc. 28(1): 38-39. 1964.

Descriptions were given of the optical and morphological properties of $CaAlH(PO_4)_2.6H_2O$, one of five new acidic calcium aluminum phosphates that may be formed by reaction of phosphatic fertilizers with soil minerals. The new salt had a striking resemblance to $CaHPO_4.2H_2O$ in its morphological and optical properties, but differed markedly in its X-ray powder diffraction pattern.

TVA, Wilson Dam, Ala.

82. Halstead, R. L. PHOSPHATASE ACTIVITY OF SOILS AS INFLUENCED BY LIME AND OTHER TREATMENTS. Canad. J. Soil Sci. 44(1): 137-144. 1964.

In laboratory incubation experiments, liming with $Ca(OH)_2$, $CaCO_3$, or $MgCO_3$, inhibited the phosphatase enzyme activity as measured by determination of phenol or phosphorus released from disodium phenyl phosphate. Chloride and sulphate salts of calcium and magnesium had no appreciable effect on the measured activity. Incubation for 9 months reduced the activity in a group of acid soils but not in a group of nearly neutral soils. Addition of phosphate prior to incubation had no effect on activity in either group.

In buffer systems with the pH controlled over the range pH 2.0 to 11.0, activity in samples of an acid mineral soil increased gradually from pH 2.0 to a maximum at about pH 7.0, and then declined rapidly. The occurrence of peaks of optimum activity at pH 5.0 and 9.5 indicated the presence of both acid and alkaline phosphatases in an organic soil.

Although there was no significant relationship between phosphatase activity and pH, clay content, nitrogen, and total carbon content of 10 mineral soils, there was a higher activity associated with higher organic matter content in three groups of soils with 3.2, 24.8, and 80.2 percent organic matter. Initial phosphatase activity of a group of mineral soils was not related to the degree of mineralization of organic soil phosphorus found to occur during an incubation period.

Soil Res. Inst., Canada Dept. Agr., Ottawa, Ontario, Canada.

83. McEvoy, E. T. THE EFFECTS OF pH AND CALCIUM ON THE UPTAKE OF RADIOPHOSPHORUS BY FLUE-CURED TOBACCO. Canad. J. Plant Sci. 44(1): 28-31. 1964.

The uptake of radiophosphorus by flue-cured tobacco as a function of pH of the culture solution was determined at five different pH values from 4 to 8. When the plants were cultured in a complete nutrient solution containing 240 p.p.m. calcium, P-32 uptake increased significantly from pH 4 to pH 5, then decreased with increasing pH to a minimum value of pH 8. At pH values, above 5, precipitation occurred as phosphates of calcium, making phosphorus less available to the plant. A reduction in the concentration of calcium in the nutrient solution to 80 p.p.m. and 0, respectively, resulted in a decrease in the amount of phosphorus precipitated and an increase in the P-32 uptake of pH 6 to 8. In calcium-free culture solutions, P-32 uptake was inhibited by hydrogen ion in the acid region of the pH range and by hydroxyl ion in the alkaline region. Growth differences were not related to variation in P-32 uptake.

Plant Res. Inst., Canada Dept. of Agr., Ottawa, Ontario, Canada.

84. Hodgson, J. F., Tiller, K. G., and Fellows, M. THE ROLE OF HYDROLYSIS IN THE REACTION OF HEAVY METALS WITH SOIL-FORMING MATERIALS. Soil Sci. Soc. Amer. Proc. 28(1): 42-46. 1964.

The proposition that hydrolysis may account for the selective adsorption of heavy metals by clay surfaces was compared with an alternate explanation of specific exchange of the metal with weakly dissociable H^+. It was shown that past evidence offered in support of the two hypotheses was somewhat ambiguous.

Theoretical treatment was presented for the competition of ions in adsorption reactions which provides a means of distinguishing between the two alternatives through the effect of H^+ on the metal-clay reaction in the presence of a competing ion. Experimentally, the effect of H^+ on the reaction of Co^{2+} with montmorillonite was studied in the presence and absence of Mg^{2+}, a weakly competing ion. Ionic strength was held constant, and nonspecific reactions were minimized with an excess of $CaCl_2$. The results were interpreted as favoring the hydrolysis hypothesis. Inherent assumptions were considered.

U.S. Soil, Plant, and Nutr. Lab., SWCRD, ARS, USDA, Ithaca, N.Y., 14850

85. Hodgson, J. F., Geering, H. R., and Fellows, M. THE INFLUENCE OF FLUORIDE, TEMPERATURE, CALCIUM, AND ALCOHOL ON THE REACTION OF COBALT WITH MONTMORILLONITE. Soil Sci. Soc. Amer. Proc. 28(1): 39-42. 1964.

Pretreatment of montmorillonite with F interferes with the adsorption of Co by montmorillonite. Since the effect is reversible with base, the F is thought to replace surface hydroxyl groups that serve as the adsorption sites for Co. The Co reaction with these sites increases with temperature, indicating that the reaction is endothermic. Therefore, either heat is required to form the Co-to-surface bond or the cation is replacing more strongly bound surface hydrogens such as those associated with the hydroxyls mentioned above. While certain other heavy metal cations were previously shown to exchange with adsorbed Co, Ca is found to have no effect on the reaction, except to alter the activity coefficient of Co in solution. This was interpreted as indicating the absence of any charge associated with the bonding site. Alcohol was found to enhance the reaction of Co with montmorillonite in contrast to what would be expected if hydrolysis played a role in the reaction.

U.S. Soil, Plant, and Nutr. Lab., SWCRD, ARS, USDA, Ithaca, N.Y., 14850

86. Lavy, T. L., and Barber, S. A. MOVEMENT OF MOLYBDENUM IN THE SOIL AND ITS EFFECT ON AVAILABILITY TO THE PLANT. Soil Sci. Soc. Amer. Proc. 28(1): 93-97. 1964.

The processes involved in Mo availability to corn and soybeans growing in soil were investigated. Both mass-flow and diffusion were involved. Mass-flow caused Mo to accumulate at or in the root when the saturation extract contained more than 4 p.p.b. Mo. Diffusion patterns were usually obtained by autoradiographic procedures when the content was below 4 p.p.b. The saturation extracts of the soils investigated ranged from 2.2 to 8.1 p.p.b. Mo. The content of labile Mo in the soil varied from 41 to 211 p.p.b. of soil. The values of Dp/b for Mo varied from 0.5 to 8.4 X 10^{-7} $cm.^2 sec.^{-1}$ and were much larger than for phosphorus (where Dp is the diffusion in a porous medium and b is a factor to account for chemical reaction with the soil).

U. Nebr., Lincoln, Nebr.

87. Noggle, J. C., Wit, C. T. de., and Fleming, A. L. INTERRELATIONS OF CALCIUM AND RUBIDIUM ABSORPTION BY EXCISED ROOTS OF BARLEY AND PLANTAIN. Soil Sci. Soc. Amer. Proc. 28(1): 97-100. 1964.

The uptake rates of Rb and Ca, applied alone or together, by excised barley and plantain roots were compared. The barley roots absorbed Rb at a faster rate than Ca, whereas the reverse was true for plantain roots. The presence of Ca increased the rate of Rb uptake by barley roots, but the presence of Rb had very little effect upon the Ca uptake. The uptake rate of either ion by plantain was reduced by the presence of the other ion.

Calculations indicated that the depressing effect of one ion on the uptake of the other by plantain was due predominantly to ionic competition when the ions were present in the concentration range of $10^{-2}\underline{N}$, but factors in addition to competition were responsible in the concentration range of $10^{-4}\underline{N}$. The significane of the differences in response of the two species was discussed.

SWCRD, ARS, USDA, Beltsville, Md., 20705

Soil Biology

SEE ALSO 74, 76, 80, 82, 103, 143, 145, 146, 158, 226.

88. Nikonov, M. N., and Perlin, S. I. CHANGES IN ORGANIC MATTER OF PEAT IN RELATION TO ITS DEGREE OF DECOMPOSITION AND TYPE. Soviet Soil Sci. 3: 261-264. Mar. 1963.

The data from group analysis of organic matter in more than 300 peat samples made it possible to trace the principal changes in composition of organic matter in peat.

As the degree of decomposition increased, peat became depleted in hydrolyzable substances (carbohydrate complex) and enriched with humic acids.

There was a distinct quantitative relationship between the changes in content of hydrolyzable substances and humic acids and degree of decomposition. Since the processes of humification proceeded during peat formation without any significant loss of organic matter and since the humic acid fraction had the highest nitrogen content, it was concluded that the carbohydrate and protein complexes of plant residues were the chief materials from which the humic acids of peat were formed as a result of microbiological activity.

The degree of decomposition was a good criterion for determining the proper use of peat with proper regard for type characteristics because it indicated the content of hydrolyzable and humic substances in peat. Peat high in hydrolyzable substances and low in humic acid was recommended for: Bedding material in barnyards and poultry houses; substrate for growing vegetables and flowers in greenhouses and seed beds; and raw materials for the hydrolysis and cellulose industries to obtain certain organic acids (acetic, oxalic).

Peat high in humic substances was recommended for: Humic fertilizers; humic acid; semicoke; and peat briquettes.

Scripta Technica Inc., 1000 Vermont Ave. N.W., Washington, D.C., 20005

89. Aristovskaya, T. V. DECOMPOSITION OF ORGANIC MINERAL COMPOUNDS IN PODZOLIC SOILS. Soviet Soil Sci. 1: 20-29. Jan. 1963.

Research on virgin podzolic soils and podzols of the Leningrad Oblast' developed on coarse- and fine-textured parent material was reported. Soil suspensions were inoculated on solid nutrient media containing gels of fulvic and ulmic acid complexes with sesquioxides, to determine the qualitative composition of the microflora involved in decomposition of the organic-mineral compounds. All the main horizons of the soil profile were investigated with due regard for the seasonal dynamics of the microflora. The author concluded that:

1. The micro-organisms that took part in the decomposition of complexes of humus substances with sesquioxides were of two groups. One group included heterotrophic species, which decomposed these compounds without necessarily concentrating the iron within them and the other group included species with an autotrophic or mixotrophic type of metabolism, which actively accumulated iron and manganese.
2. Small soil amoebea, the new oligotrophic organism Seliberia stellata Arist. et Parink., and some other bacteria were representives of the first group. The second group consisted chiefly of little studied micro-organisms (Pedomicrobium ferrugineum Arist., Pedomicrobium manganicum Arist. and Pedomicrobium podzolicum n. sp.).
3. The decomposition of mineral-organic complexes by heterotrophic micro-organisms sometimes resulted in some accumulation (generally slight) of aluminum and iron hydroxides released in the process. The activity of the autotrophic and mixotrophic micro-organisms caused a high concentration of iron and manganese owing to oxidation of the lower forms of these elements into the higher forms.
4. The micro-organisms played a major role in soil formation. By decomposing complexes of soil humus with sesquioxides and concentrating iron and manganese (in concretions or bands), they promoted the accumulation of the hydroxides of these elements in certain soil horizons. The oligotrophic species, which accumulated nitrogen and elements of mineral nutrition in a dispersed state, prevented them from becoming leached out of the soil and thus helped to maintain soil fertility.
5. The process of biological concentration of iron and manganese in coarse-textured soils took place chiefly within the illuvial and, in part, podzolic horizons. It did so in fine-textured soils within the podzolic and, in part, accumulative horizons.
6. The close relationship between the processes of biological decomposition of humus substances by micro-organisms with the transformation of iron and manganese was characteristic of the microbiology of podzolic soils, and it was regarded as a zonal phenomenon.

Scripta Technica Inc., 1000 Vermont Ave. N.W., Washington, D.C., 20005

90. Kaurichev, I. S., Ivanova, T. N., and Nordrunova, Y. M. LOW-MOLECULAR ORGANIC ACID CONTENT OF WATER-SOLUBLE ORGANIC MATTER IN SOILS. Soviet Soil Sci. 3: 223.229. Mar. 1963.

Low-molecular organic acids were determined in water extracts from spruce, moss (spahgnum), and mixed (birch + spruce and pine) litter obtained under natural conditions in May, July, and October. They were regularly found in such extracts, the largest quantity in spruce and mixed litter, the smallest--in spagnum litter.

The water-soluble organic matter migrating through the profile of virgin podzolic, sod-podzolic, and podzolic soils of forest-steppe depressions, solods, and solonetzes contained low-molecular organic acids averaging 3 to 6 percent of the total carbon in the migrating organic matter.

The largest quantity of low-molecular organic acids was found in the water-soluble organic matter of podzolic and peat-podzolic soils in the central Taiga.

The qualitative composition of the organic acids was represented by volatile (oxalic, citric, fumaric, and glycolic) and nonvolatile (formic) acids.

The water-soluble organic matter of podzolic and peat-podzolic forest soils in the central Taiga had the most varied qualitative composition of organic acids.

Scripta Technica Inc., 1000 Vermont Ave. N.W., Washington, D.C., 20005

91. Hinman, W. C. FIXED AMMONIUM IN SOME SASKATCHEWAN SOILS. Canad. J. Soil Sci. 44(1): 151-157. 1964.

Nitrogen, as fixed ammonium, occurred in five profiles of arable soil of different textures. The amounts increased with increasing soil depth in four of the profiles. Total amounts found in the 4-ft. profiles varied from 2600 to 4600 lb./A and ranged from 7 percent of the total nitrogen in the surface soil to as much as 58 percent in the soil at the 4-ft. depth.

When the fixed ammonium nitrogen was subtracted from the total nitrogen, the C:N ratios of these soils increased very sharply with depth, indicating that the subsoil organic matter was less rich in nitrogenous substances than was that of the surface soil.

The clay fractions of the profiles were mineralogically similar and contained essentially the same amounts of fixed ammonium, approximately 2.4 meq. ammonium per 100 g. of silt. These fractions accounted for nearly all the fixed ammonium nitrogen observed except in the coarser-textured soils.

Fixed ammonium and total nitrogen analysis of 25 paired samples of cultivated and virgin soil indicated that although the average total nitrogen had been reduced by one-third, there had been little or no effect on the amount of fixed ammonium N in the surface soil.

Expt. Farm, Canada Dept. Agr., Swift Current, Saskatchewan, Canada.

92. Smirnov, P. M., and Fruktova, N. I. FIXATION OF NONEXCHANGEABLE AMMONIUM BY SOILS. Soviet Soil Sci. 3: 265-272. Mar. 1963.

When fertilizers are added to the soil, the cations of their soluble salts are absorbed by the colloidal fraction of the soil. The cations adsorbed by the soil are usually considered as a readily available source of nutrients for plants. In addition to exchangeable cations that are highly mobile, the soils may contain a certain amount of cations that are fixed in the absorbed state, are not mobile, and are not readily available to plants.

The capacity of different soils to fix nonexchangeable ammonium were determined. The availability of fixed, nonexchangeable ammonium to plants grown in pots in greenhouses were studied. The author concluded that:

1. Many soils, in addition to adsorbed ammonium in the exchangeable form, were capable of fixing a considerable amount of ammonium in the nonexchangeable form that could not be extracted with a KCl solution.
2. In their natural state, solids contained a certain amount of fixed nonexchangeable ammonium. Soil to which mineral fertilizers and manure had been systematically added, as well as soils of a higher degree of cultivation showed a tendency to accumulate ammonium fixed in a nonexchangeable form. At the same time, the capacity of such soils to fix additional ammonium decreased.
3. The total capacity of chernozem soils to fix nonexchangeable ammonium was much higher than in sod-podzolic soils; soils of a finer texture were capable of fixing more ammonium in the nonexchangeable form than soils of a coarser texture.
4. The capacity to fix nonexchangeable ammonium and the total capacity of the soil to fix ammonium increased with depth along the soil profile.
5. Ammonium that was fixed by soils in a nonexchangeable form was not readily available to nitrifying bacteria and, especially, to plants.
6. The capacity of some soils to fix considerable amounts of ammonium in a nonexchangeable form must be considered in the practical use of fertilizers.

Scripta Technica Inc., 1000 Vermont Ave. N.W., Washington, D.C., 20005

93. Birch, H. F. MINERALIZATION OF PLANT NITROGEN FOLLOWING ALTERNATE WET AND DRY CONDITIONS. Plant and Soil 20(1): 43-49. 1964.

Nitrogen mineralization during the decomposition of plant samples containing from 1.0 to 2.9 percent nitrogen was studied under uninterrupted moist conditions of 21, 27, and 33 days and for the same periods interrupted by 1, 2, and 3 dryings. After 15 days moist, the samples were air dried for 3 weeks, moistened, and kept moist for a further 6 days.

Intermittent drying enhanced the amount of nitrogen mineralized and the effect was cumulative with increasing numbers of the drying cycles. The more decomposed the material subjected to drying, the greater was the effect.

Plant material containing as little as 1.5 percent nitrogen released mineral nitrogen after 33 days decomposition interrupted by three drying cycles but not during uninterrupted decomposition. With material containing 2 percent nitrogen, a single drying cycle was sufficient to bring about a release of nitrogen which did not occur under more prolonged uninterrupted moist conditions. With samples containing 2.5 percent nitrogen and over, mineral nitrogen was produced during uninterrupted decomposition periods of 21, 27, and 33 days. For the same moist periods interrupted by one or more drying cycles, the amount of mineral nitrogen produced was much greater.

It was concluded that where pronounced and frequent wet and dry periods occur, the addition of plant material of nitrogen content down to 1.5 percent was more effective in supplying mineral nitrogen than under constant moist conditions. The detrimental effect of adding low nitrogen residues to the soil was less pronounced under alternate wet and dry than constant moist conditions.

Makerere U. Col. Box 262, Kampala, Uganda

94. Brandt, G. H., Wolcott, A. R., and Erickson, A. E. NITROGEN TRANSFORMATIONS IN SOIL AS RELATED TO STRUCTURE, MOISTURE, AND OXYGEN DIFFUSION RATE. Soil Sci. Soc. Amer. Proc. 28(1): 71-75. 1964.

The aeration status of a Brookston cl was varied by varying aggregate size, moisture content, and moisture tension. Moisture tensions ranged from saturation to about field capacity. Determinations for pH, NH_4^+, NO_3^- and oxygen diffusion rate were made periodically during 2 months' incubation at 35° C. Oxygen diffusion rate was determined amperometrically, using platinum electrodes 4 mm. long by 0.8 mm. in diameter. Average rates associated with aggregate size and moisture content ranged from 3 to 43 g. $O_2 \times 10^{-8}$ cm.$^{-2}$ minute^{-1}.

Fluctuations in oxygen diffusion rate with time paralleled changes in concentrations of NH_4^+ and NO_3^- and appeared to reflect changes in metabolic demand for oxygen by components of the microbial population other than the nitrifiers.

Large discrepancies between NH_4^+ disappearance and NO_3^- accumulation made it necessary to distinguish between nitrification as the biological oxidation of reduced forms of nitrogen and net nitrification as the observed accumulation of nitrate.

Net nitrification varied with apparent delay period and rate of NH_4^+ oxidation, and with losses of nitrified N. Rates of ammonium oxidation were related directly to the general level of oxygen supply as measured grossly with the platinum electrode. Apparent delay periods were influenced primarily by anearobic metabolism in microenvironments too small to be differentiated by the electrodes which were used. Mineral N deficits appeared to be due primarily to enzymatic denitrification at oxygen diffusion rates less than 20; at higher levels of oxygen supply, chemical instability of NO_2^- appeared to become increasingly important because of an accompanying decrease in pH.

Mich. Agr. Expt. Sta., East Lansing, Mich.

95. Gallagher, P. A., and Bartholomew, W. V. COMPARISON OF NITRATE PRODUCTION AND OTHER PROCEDURES IN DETERMINING NITROGEN AVAILABILITY IN SOUTHEASTERN COASTAL PLAIN SOILS. Agron. J. 56: 179-184. 1964.

Nitrate production in a 14-day incubation period was determined in 54 selected Coastal Plain soils in North Carolina and was compared with total N organic matter content, acid extractable N, and carbonate extractable N, as an index of N availability. Factors affecting the biological production of NO_3-N were investigated and some modifications of the nitrate production procedure were employed. The modified procedure was better than the unmodified procedure for predicting available N in Coastal Plain soils. However, the chemical methods were still more closely correlated with greenhouse cropping evaluations of N availability than were the regular or the modified biological incubation procedures.

Res. Off., Agr. Inst. Johnstown Castle Agr. Col., Wexford, Ireland.

96. Reedy, G. R. EFFECT OF MIXING VARYING QUANTITIES OF DICYANDIAMIDE WITH AMMONIUM FERTILIZERS ON NITRIFICATION OF AMMONIA IN SOILS. Canad. J. Soil Sci. 44(2): 254-259. 1964.

A series of laboratory experiments were conducted to evaluate the effect of dicyandiamide on the transformation of fertilizer nitrogen in Georgia soils. These studies indicated that dicyandiamide inhibited nitrification of ammonium sulphate at all rates utilized. The inhibitory action of dicyandiamide was attributed to its toxic effect on the nitrifying organisms which failed to function in the presence of dicyandiamide. Complete nitrification eventually occurred but only after a long period.

Decomposition of dicyandiamide was more rapid in fine-textured Cecil sl containing relatively more organic matter than on the coarse-textured and low organic matter Lakeland s soil. Soil texture and organic matter content must be considered in evaluating the length of time that dicyandiamide will inhibit nitrification in any given soil.

Sucrose apparently provided a quickly available source of energy for soil microorganisms that utilized the dicyandiamide as a source of nitrogen and preventing its inhibiting effect on nitrification. The nitrogen from the dicyandiamide was eventually mineralized as indicated by the higher total ammonium and nitrate nitrogen found at the end of incubation period.

Col. Agr., Osmania U., Rajendrangar, Hyderabad-30, India.

97. MacLeod, L. B., Bishop, R. F., Calder, F. W., and MacEachern, C. R. EFFECT OF VARIOUS RATES OF LIMING AND FERTILIZATION ON CERTAIN CHEMICAL PROPERTIES OF A STRONGLY ACID SOIL AND ON THE ESTABLISHMENT, YIELD, BOTANICAL, AND CHEMICAL COMPOSITION OF A FORAGE MIXTURE. Canad. J. Soil Sci. 44(2): 237-247. 1964.

In a field experiment, application of increasing rates of dolomitic limestone and 0-20-20 fertilizer to a strongly acid sandly loam produced marked changes in the chemical properties of the soil and in the composition and yield of a forage mixture grown thereon. The magnitude of the changes decreased as rates of limestone and fertilizer increased.

Liming the soil caused decreases in exchangeable K and in Al extractable with N KCl. The latter change was particularly marked when soil pH was raised from 4.6 to 5.4.

Legume species showed good establishment at all pH levels above 5.4 and relative sward density was highest at a pH of 6.2 to 6.6.

Irrespective of fertilization rate, dry-matter yields of forage were practically doubled by the 2.5-ton rate of limestone which changed soil pH from 4.6 to 5.4. There were also marked yield increases from fertilizer regardless of liming rate. Optimum yields resulted from liming to pH 6.0-6.5 and application of 400 lb./A of 0-20-20.

Expt. Farm, Canada Dept. Agr., Nappan, Nova Scotia, Canada.

98. Corke, C. T., and Chase, F. E. COMPARATIVE STUDIES OF ACTINOMYCETE POPULATIONS IN ACID PODZOLIC AND NEUTRAL MULL FOREST SOILS. Soil Sci. Soc. Amer. Proc. 28(1): 68-70. 1964.

A comparision was made of the actinomycete populations of acid podzol and neutral mull soils under forest cover. In both soils, numbers decreased with depth though less rapidly than did the combined bacteria and fungi; consequently the actinomycetes were, proportionately, slightly more numerous in the lower mineral horizons. The actinomycetes in the podzol were more acid tolerant than those from the mull soils. Approximately two-thirds of the isolates from the podzol grew at pH 4.5 and one-third at pH 4.0. Of the isolates from the mulls only one-sixth were capable of growth at pH 4.5 and none grew at pH 4.0. The acidic environment restricted actinomycete development to from five to seven "species groups" of Streptomyces.

Ontario Agr. Col., Guelph, Ontario, Canada.

99. Chandra, P. HERBICIDAL EFFECTS ON CERTAIN SOIL MICROBIAL ACTIVITIES IN SOME BROWN SOILS OF SASKATCHEWAN. Weed Res. 4(1): 54-63. 1964.

Amitrole, 2,3,6-TBA, 2,4-DB, and di-allate were applied at normal field rates to a loam soil. The toxic effects, as measured by nitrification studies, persisted for 8 weeks after application. After a further 8 weeks this depressive effect was decreased.

Residual effects were assayed by measuring the nitrification rate of soils following the application of the same four herbicides at two rates to four different soils. The residual effects of amitrole, di-allate, 2,3,6-TBA, and 2,4-DB were overcome 34, 28, 32, and 44 weeks respectively after treatment. Total microbial counts were also correlated with the nitrification rate of the soils. The trend of disappearance of the toxic effect of these chemicals was similar in all the soils studied.

Under field conditions, the residual effect of amitrole, 2,3,6-TBA, and 2,4-DB had disappeared by the end of 52 weeks, as far as could be determined by studies of nitrate production, ammonification, and total counts of microorganisms. A second application of the chemicals 56 weeks after the initial treatment affected nitrification in the laboratory for only half as long, indicating adaptation of the microorganisms to the herbicides.

Expt. Farm, Res. Br., Canada Dept. Agr., Swift Current, Saskatchewan, Canada.

100. McKell, C. M., and Whalley, R. D. B. COMPATIBILITY OF 2-CHLORO-6(TRICHLOROMETHYL) PYRIDINE WITH MEDICAGO SATIVA L. INOCULATED WITH RHIZOBIUM MELILOTI. Agron. J. 56(1): 26-28. 1964.

Greenhouse tests indicated no reduction in the survival of Rhozobium meliloti on alfalfa seeds and in soil fertilized with ammonium sulfate treated with 2-chloro-6(trichloromethyl) pyridine. Reduction in seedling growth of alfalfa plants was severe at 20 p.p.m. of 2-chloro-6-(trichloromethyl) pyridine and slight at 1 p.p.m.

Other deleterious effects on alfalfa seedlings were changes in nodule morphology and deformation of root tips.

U. Calif., Riverside, Calif.

Soil-Plant-Animal Relationships

SEE ALSO 41, 57, 100, 143, 155, 156, 157, 161, 162, 163, 164, 171, 178, 181, 182, 186, 189, 214, 224, 294, 301.

101. Armstrong, R. W. SPECTROGRAPHIC ANALYSES OF PASTURE GRASS AND DRINKING WATER IN RELATION TO STOMACH CANCER MORTALITY IN ICELAND. Acta Agr. Scandinavia 14(1): 65-76. 1964.

Samples of plant materials and drinking water taken from farms with and without records of cancer of the stomach in two rural districts of Iceland were analyzed spectrographically. On the basis of the method used, there were no statistically significant differences between mean values for elements previously implicated with cancer. If the soil is linked with cancer or other human disease, it is through a complex food chain extending from plants and animals, through the cultural processes of food preparation, to the individual variability of human beings. There is need for more reliable methods to measure the relative amounts of soil elements in the diet.

U. Ill., Urbana, Ill.

102. Baker, D. E., Gosline, G. W., Smith, C. B., Thomas, W. I., Grube, W. E., and Ragland, J. L. TECHNIQUE FOR RAPID ANALYSES OF CORN LEAVES FOR ELEVEN ELEMENTS. Agron. J. 56(2): 133-136. 1964.

An investigation was conducted to develop methods for an over-all analytical technique of corn leaf analysis. Samples were analyzed by use of a spectrometer for Sr, P, K. Ca, Mg, Mn, Cu, B, Al, Fe, and Zn. Computing equipment was used to speed and facilitate data conversion. Procedures for sampling, leaf washing, drying, grinding, mixing, ashing, and analysis were studied and modified, where necessary, to increase precision and accuracy with respect to all elements.

Pa. Agr. Expt. Sta., University Park, Pa.

103. DeRemer, E. D., and Smith, R. L. A PRELIMINARY STUDY ON THE NATURE OF A ZINC DEFICIENCY IN FIELD BEANS AS DETERMINED BY RADIOACTIVE ZINC. Agron. J. 56(1): 67-70. 1964.

Great Northern beans were grown in growth chambers in the Portneuf sil soil to which sugar beet tops were added at the rate of 0, 15, 30, and 45 tons fresh weight per acre-6-inches.

The soil and organic material were allowed to incubate at 80° F. in growth chambers for either 0 to 6 weeks prior to planting the beans. Tracer amounts of Zn-65 were added at the time of organic matter incorporation. The plants (3 per container) were grown for 6 weeks, harvested, and their Zn-65 uptake counted. The plant growth and uptake of Zn-65 were reduced by each increment of added sugar beet tops only if an incubation period had preceded the seeding. A $ZnSO_4$ spray given to some of the plants after they had developed chlorosis (2 weeks after emergence) eliminated the deficiency and negated the effect of the organic matter on yields.

Fractionation of the soil showed that the water-soluble, acid-extractable, and $CaCl_2$-extractable Zn-65 in the soil were reduced when the soil and organic matter had been incubated. The Zn-65 found in the non-extractable fraction of the soil also was higher in the incubated soils. It was postulated that the decomposing organic material and the microflora had reduced or tied up the available soil Zn.

Northeastern Jr. Col., Sterling, Colo.

104. McGregor, A. J., and Wilson, G. C. S. THE EFFECT OF APPLICATIONS OF MANGANESE SULPHATE TO A NEUTRAL SOIL UPON THE YIELD OF TUBERS AND THE INCIDENCE OF COMMON SCAB IN POTATOES. Plant and Soil 20(1): 59-64. 1964.

Potatoes grown on a neutral soil with low water-soluble managanese content gave a normal crop with no signs of manganese deficiency. Treatment with manganese sulphate (0.5 cwt. per acre) mixed with a compound fertilizer and applied in the drill at planting time, increased the manganese content of leaves and tubers but had no effect on the total yield of tubers. The manganese treatment, however, increased the average weight of tuber and markedly reduced the incidence of scab. The results suggest a possible method of controlling scab in neutral soils.

W. Scotland Agr. Col., Glasgow, Scotland.

105. Foy, C. D., and Brown, J. C. TOXIC FACTORS IN ACID SOILS: II. DIFFERENTIAL ALUMINUM TOLERANCE OF PLANT SPECIES. Soil Sci. Soc. Amer. Proc. 28(1): 27-32. 1964.

Differential Al tolerance of plant species in nutrient solution and in acid Bladen soil was closely associated with the ability of plants to absorb and utilize P in the presence of excess Al.

Chelating agent (EDDHA), added to the nutrient solution portion of a split medium, increased the solubility of Al but decreased its toxicity to Al-sensitive plants. EDDHA at 1/4 the molarity of the Al added gave near-maximum yields for Al-tolerant buckwheat. For Al-sensitive barley, EDDHA at twice the molarity of the Al was required for normal growth. The beneficial effects of EDDHA on Al-sensitive barley in nutrient solution were associated with marked increases in the solubility of P and with increased uptake of P by plants.

SWCRD, ARS, USDA, Beltsville, Md., 20705

106. Miltimore, J. E., McArthur, J. M., Mason, J. L., and Carson, R. B. BLOAT INVESTIGATIONS: II. A COMPARISION OF THE TRUE PROTEIN AND ELEMENT CONTENTS OF ALFALFA HAY FROM BLOATING AND NON-BLOATING FARMS. Canad. J. Plant Sci. 44(2): 175-181. 1964.

Alfalfa samples at the hay stage of development were harvested by hand from 35 farms where bloat was a serious problem and from 38 farms where bloat did not occur even on lush legume pastures. The samples were analysed for nitrogen, phosphorus, potassium, sulphur, calcium, magnesium, and true protein. There were no differences in the mean contents of these constituents between bloating and non-bloating farms. There were wide ranges within both types of farms; true protein varied from 7.3 to 14.6 percent in alfalfa from bloating farms, with a similar range from 7.7 to 16.9 percent from non-bloating farms. Correlation coefficients revealed a significant association between nitrogen and phosphorus (.488) in alfalfa from non-bloating farms. There were significant associations between sulphur and nitrogen (.366) and between sulphur and protein (.707) in alfalfa from bloating farms. This correlation between sulphur and protein was the only coefficient that was significantly different from the corresponding correlation coefficient for non-bloating farms.

Res. Sta., Canada Dept. Agr., Summerland, British Columbia, Canada.

107. Dotzenko, A. D., and Henderson, K. E. PERFORMANCE OF FIVE ORCHARDGRASS VARIETIES UNDER DIFFERENT NITROGEN TREATMENTS. Agron. J. 56(2): 152-155. 1964.

Five orchardgrass varieties developed in diverse areas of the United States were evaluated for yield, total N and P contents, NO_3 accumulation, and recovery of applied N under four levels of N fertilization on a Nunn cl at Fort Collins, Colo.

Forage yields were closely associated with the amount of N applied, with most varieties showing increased yields at the higher rates of N. The magnitude of the increase varied with varieties as well as with the rates of N applied. The Latar variety produced the highest yields under all applied levels.

Nitrogen fertilizer increased the percent total N in all varieties. The Latar variety had the highest percentage.

The level of N fertilizer and the variety of orchardgrass had a great effect on the NO_3 concentration. N fertilizer increased the NO_3 content of all varieties with Latar having the highest values with the Commercial variety having the lowest values particularly at the higher fertilization rates.

Percent N recovery and percent P were inversely related to the amount of fertilizer applied, all varieties showing marked reduction as the N fertilizer rates increased. The magnitude of the reduction in percentages varied according to variety and level of fertility. Latar had the highest values of both percent N recovery and P content.

The interaction of varieties x years was not significant in any of the factors that were measured, thus indicating that the varieties responded the same way each year even though the years were quite different.

The Latar variety gave the greatest respone to N fertilizer in terms of yield, total N percent, percent N recovery, and percent P under the environmental conditions of northern Colorado.

Colo. Agr. Expt. Sta., Fort Collins, Colo.

108. Burton, G. W., Knox, F. E., and Beardsley, D. W. EFFECT OF AGE ON THE CHEMICAL COMPOSITION, PALATABILITY AND DIGESTIBILITY OF GRASS LEAVES. Agron. J. 56(2): 160-161. 1964.

Young leaf blades harvested from the top of heading culms of Gahi-1 pearl millet and Georgia 337 sudangrass contained more crude protein, more true protein, and less lignin than older bottom leaves taken from the same culms. Young and old leaves did not differ in cellulose or total available carbohydrate content, but young leaves were unquestionably more palatable to cattle than old leaves.

Relative digestible dry matter values were obtained for millet leaves by subjecting dried forage samples in nylon mesh bags to a 72-hour digestion period in rumen fistulated steers and determining the disappearance of dry matter. Young leaves of three late-maturing pear millet genotypes gave an in vivo dry-matter digestibility of 75.3 percent whereas old leaves were only 61.4 percent digestible.

Eighteen successive leaves from top to bottom on two late-maturing millet plants ranged from 73.9 to 58.2 percent in digestible dry matter. Genotypes differed significantly in dry-matter digestibility.

CRD, ARS, USDA, Tifton, Ga.

109. Dobie, J. B., Goss, J. R., Kepner, R. A., Meyer, J. H., and Jones, L. G. EFFECT OF HARVESTING PROCEDURES OF HAY QUALITY. Trans. ASAE 6(4): 301-303. 1963.

Packaging hay at low moisture content and during the dry part of the day caused only a 4 percent loss in yield, compared to a 25 percent loss when the hay was raked too dry. Hay that was both raked and packaged dry yielded 35 percent less than hay that was handled properly. In each case, the loss of protein was somewhat greater than the yield loss, indicating that the reduction in yield was predominantly leaves. When the hay was fed to sheep, the reduction in hay quality resulting from field treatments was similarly reflected in smaller weight grains.

Wafered hay was equal to chopped hay as a feed; the same hay, pelleted, resulted in increased gains with sheep. Conditioning had little effect except in increasing the curing rate.

U. Calif., Davis, Calif.

110. Knoll, H. A., Brady, N. C., and Lathwell, D. J. EFFECT OF SOIL TEMPERATURE AND PHOSPHORUS FERTILIZATION ON THE GROWTH AND PHOSPHORUS CONTENT OF CORN. Agron. J. 56(2): 145-147. 1964.

In a greenhouse experiment, the effect of P fertilizer on growth and P uptake by corn was studied at soil temperatures of 15° C, 20° C, and 25° C. Two soils (an acid Mardin sil and a neutral Honeoye sil), three different fertilizer sources (monocalcium phosphate, dicalcium phosphate, and a mixture of the two), 2 fertilizer rates (35 and 70 lbs. P/A.), and two fertilizer placements (mixed with the soil and banded) were used. Dry weight and P content were determined at two harvest dates (3 and 5 weeks).

The different P sources did not affect dry weight or the P content of the corn tissue. In both soils, dry weight increased with increased soil temperature. The P content and P uptake by the tops increased with increasing soil temperature and with increasing P level in the soil in both soils. Placement of fertilizer in a layer below the seed was advantageous over the mixed placement in both soils at low soil temperature. The advantage was greater with the Mardin soil. Under no circumstances, however, in either soil did the addition of fertilizer P completely alleviate the harmful effects of low soil temperature as measured by growth, P content, or P uptake.

N.Y. State Col. Agr., Cornell U., Ithaca, N.Y.

111. Clark, R. E. DIRECT AND RESIDUAL EFFECTS OF TWO MIXTURES OF NITROGEN AND PHOSPHORUS UPON THE GROWTH OF ACALA COTTON IN THE PECOS VALLEY. Agron. J. 56(1): 18-20. 1964.

The yield of lint was linearly correlated with other characteristics of Acala cotton plants grown in the field.

The increase in N applied increased the N content of the aboveground tissues, the number of axis nodes, the length of the plants, the yield of dry matter, the uptake of N, the number of harvestable bolls, and the uptake of P. The content of P, was increased negligibly by the amount of N applied as two ratios of N and P but was not correlated with the yield of lint. The linear regressions of yield of lint on the 7 plant characteristics obtained for 3 consecutive years contained both the direct and residual effects of these treatments of N and P. Apparently, the direct and residual effects of N applied during the fruiting period dominated other environmental factors involved in the growth and fruiting of Acala cotton in the Pecos Valley of New Mexico.

Southeastern Substation, Agr. Expt. Sta. of N. Mex., Artesia, N. Mex.

112. McKercher, R. B. SUMMERFALLOW WHEAT PROTEIN VARIATIONS IN SASKATCHEWAN. Canad. J. Soil Sci. 44(2): 196-202. 1964.

Field studies were conducted during the years 1957-62 to measure and delineate factors which cause the protein variations encountered in summerfallow wheat crops in Saskatchewan. Differences in protein content of wheat of over 7 percent were found between different sampling topographical positions within any one field. Fertilization with nitrogen and phosphate at recommended field rates did not alter the protein content of the grain even though increases in yield of up to 100 percent were measured.

Much of the variation in protein values of wheat within fields could be attributed to changes in the type of soil profile and the associated microclimate.

U. Saskatchewan, Saskatoon, Saskatchewan, Canada.

113. Findlay, W. I., and Fulton, J. M. THE NUTRIENT COMPOSITION OF HYBRID CORN AS INFLUENCED BY FERTILIZATION: II. THE PHOSPHORUS PERCENTAGE. Canad. J. Soil Sci. 44(2): 217-222. 1964.

Field experiments conducted during the years 1957-60 provided an opportunity to assess the effects of fertilizer applications on the phosphorus percentage of corn leaves.

It was concluded that variation in leaf phosphorus percentage may reflect the sufficiency of nitrogen supply, soil type, seasonal variables, and method of phosphorus placement as well as phosphorus supply.

Res. Sta., Canada Dept. Agr., Harrow, Ontario, Canada.

114. Fuehring, H. D., and Soofi, G. S. NUTRITION OF CORN ON A CALCAREOUS SOIL: II. EFFECT OF ZINC ON THE YIELDS OF GRAIN AND STOVER IN RELATION TO OTHER MICRONUTRIENTS. Soil Sci. Soc. Amer. Proc. 28(1): 79-82. 1964.

The effect of row-applied Zn, B, Fe, Mn, and Cu on grain and stover yields and on the sixth leaf composition of corn grown on a calcareous soil was studied using a central composite factorial. Grain yield was decreased by application of the micronutrients studied. The yield of stover, however, was considerably enhanced at all levels of applied Zn indicating that response to Zn was directly opposite between vegetative and storage parts of the plant. Concentration of Zn in the sixth corn leaf ranged from 20 to 145 p.p.m. Grain yield was relatively high at 20 p.p.m. while yield of stover was highest at the 145 p.p.m. Zn content. A highly significant positive interaction between Zn and Mn on grain yield indicated that increasing either element decreased the toxic effect of the other. However, the Zn-Mn interaction was negative for yield of stover, and increasing Mn tended to decrease yield at the higher levels of applied Zn. A possible interference of Zn with the translocation of carbohydrates to the storage organs was postulated. The optimum Zn level in the leaves for grain production was affected to the greatest extent by the level of Mn, low Mn in the leaves resulting in a low Zn requirement while higher concentrations of Mn in the leaves resulted in a high Zn requirement for both grain and stover.

Amer. U. Beirut, Beirut, Lebanon.

115. Hill, K. W. PROTEIN CONTENT OF WHEAT AS AFFECTED BY AGRONOMIC PRACTICES. Canad. J. Plant Sci. 44(2): 115-122. 1964.

Extensive field studies were made throughout the Prairie Provinces over a 4-year period on the effect of four agronomic practices on the protein content of hard red spring wheat. Wheat grown on fallow was usually higher in protein percentage than that grown on stubble. There was no striking difference in the protein content of wheat grown on "trash-cover" fallow and black fallow. Spraying with 2,4-D for weed control did not affect the protein percentage. The application of nitrogen either as a fertilizer to the soil or as a urea spray to the plants at the flowering stage usually raised the protein content of the grain.

Res. Br., Canada Dept. Agr., Ottawa, Ontario, Canada.

116. Bishop, R. F., Jackson, L. P., MacEachern, C. R., and MacLeod, L. B. A LONG-TERM FIELD EXPERIMENT WITH COMMERCIAL FERTILIZERS AND MANURE: III. FERTILITY LEVELS, CROP YIELDS, AND NUTRIENT LEVELS IN CORN, OATS, AND CLOVER. Canad. J. Soil Sci. 44(1): 56-65. 1964.

Changes in adsorbed plus easily acid-soluble phosphorus in soil were generally proportional to the amounts of phosphorus applied.

All treatments were applied in the corn year and the phosphorus content of fertilizers was reflected in the percent total phosphorus in tissue samples of corn and the succeeding oat and clover crops. Application of fertilizers containing increasing percentages of potassium consistenly increased the percent total potassium in corn and oats but not in clover. However, application rates of manure were invariably reflected in the percentages of total phosphorus and potassium in all crops. With 20 tons of manure, corn, oats, and clover contained 0.33, 0.28, and 0.27 percent phosphorus and 2.51, 1.92, and 1.42 percent potassium.

Application of fertilizers with increasing percentages of nitrogen did not produce significant yield differences in any of the crops. However, use of fertilizers containing increasing percentages of phosphorus or potassium resulted in significantly increased corn yields. All crop yields were significantly higher with 20 tons of manure than with 1,000 lb. of 4-8-8 fertilizer. With this rate of manure, corn produced 3.18 tons of dry matter, oats approximately 52 bu. of grain, and hay 2 tons of dry matter per acre.

Res. Sta., Canada Dept. of Agr., Kentville, Nova Scotia, Canada.

117. Ellis, R., Jr., Davis, J. F., and Thurlow, D. L. ZINC AVAILABILITY IN CALCAREOUS MICHIGAN SOILS AS INFLUENCED BY PHOSPHORUS LEVEL AND TEMPERATURE. Soil Sci. Soc. Amer. Proc. 28(1): 83-86. 1964.

Yield of corn was increased from 7,504 to 8,680 pounds per acre by an application of 4 pounds of Zn per acre to a calcareous Wisner cl in a field experiment. In a greenhouse experiment with the same soil, yield, Zn concentration in the plant tissue, and total Zn uptake by corn were decreased when soil temperature was decreased from 75° F to 55° F. Ten pounds of Zn per acre increased the Zn concentration in the corn tops.

In a greenhouse experiment with a Kawkawlin-Wisner l, 10 pounds of Zn per acre increased the yield of field beans when the treatments included high levels of either applied or residual P. In greenhouse experiments, applications of 437 and 655 pounds of P per acre decreased the Zn concentration in field beans and corn. In most experiments, a negative correlation was noted between Zn and P concentrations in the plant tissue.

Jr. Author, Mich. Agr. Expt. Sta., East Lansing, Mich.

SEE ALSO 19, 25, 53, 60, 62, 68, 73, 75, 76, 78, 79, 80, 88, 89, 91, 94, 95, 96, 98, 99, 103, 105, 107, 110, 112, 113, 114, 117, 136, 139, 143, 157, 167, 168, 176, 178, 193, 215, 243, 268, 299, 306, 318.

118. Reeder, S. W., and Odynsky, W. MORPHOLOGICAL AND CHEMICAL CHARACTERISTICS OF THE SOLONETZIC SOILS OF NORTHWESTERN ALBERTA. Canad. J. Soil Sci. 44(1): 22-23. 1964.

The morphological characteristics and average chemical properties for 69 Solonetzic soils of northwestern Alberta were presented. The chemical data included: Conductivity and soluble salts; exchangeable cations and exchange capacity; ph; organic carbon; and total calcium, magnesium, and sodium.

The soils classified as Solonetz and Solodized Solonetz possessed properties in agreement with the limits proposed for soils of the Solonetzic Order, whereas the soils classified as Solods had chemical properties that placed them in a borderline position with the soils of this Order. It was proposed that consideration be given to the classification of a group of soils developed on saline materials that have a characteristic morphology and possess chemical properties that do not quite meet the limits required for soils of the Solonetzic Order.

Res. Council Alberta, Edmonton, Alberta, Canada.

119. St. Arnaud, R. J., and Whiteside, E. P. MORPHOLOGY AND GENESIS OF A CHERNOZEMIC TO PODZOLIC SEQUENCE OF SOIL PROFILES IN SASKATCHEWAN. Canad. J. Soil Sci. 44(1): 88-99. 1964.

Chemical, physical, and micropedological studies were made of Orthic Black, Orthic Dark Grey, Dark Grey Wooded, and Orthic Grey Wooded profiles developed from relatively uniform glacial till material. The general gradation of morphological properties observed for the Black to the Grey Wooded soils was reflected in the thickness of the A_h horizons and of the sola, the development of A_e and textural B horizons, and in the structure and micro-fabrics of the soil horizons.

All four soils were highly base-saturated, calcium was the dominant cation on the exchange complex. Particle size distribution has been affected by both translocation of clay as well as by physical breakdown of coarse fractions particularly within surface horizons. Iron translocation within all four profiles appeared to be closely associated with clay movement. The uniform iron content of the fine clay fraction indicated that iron may occur as an integral part of the clay structures and that the clays have undergone little alteration as a result of weathering.

U. Saskatchewan, Saskatoon, Saskatchewan, Canada.

120. Zaytsev, B. C. ROLE OF HUMUS, EXCHANGEABLE CALCIUM AND CLAY IN THE FORMATION OF THE STRUCTURE OF HUMUS-ELUVIAL HORIZONS IN FOREST SOILS. Soviet Soil Sci. 6: 583-588. June, 1963.

The humus-eluvial (actually, humus-eluvial and humus-podzolic) horizons of Gray Forest and Podzolic soils under dense forest were studied. The presence of a well-defined structure in these horizons was associated with the clay loam and clayey nature of the soil-forming deposits. Samples of the humus-eluvial horizons of gray forest soils were taken in the oak forests of the Tula, Voronezh, and Sumy Oblast's and those of the humus-podzolic horizons of Podzolic soils, in the spruce and spruce-oak forests of Moscow Oblast'. The author concluded that:

1. The major factor determining the formation of a blocky structure in the humus-podzolic horizons of forest Podzolic soils and the nutty-granular structure of humus-eluvial horizons in Gray Forest soils was humus. There was a correlation between the content of humus in these horizons and the content of water-stable aggregates 10-0.25 mm. in diameter. The structure-forming role of humus was manifest only in clay loam and clay soil-forming deposits.
2. The effect of exchangeable calcium on the formation of the structure of humus-eluvial horizons in forest soils was indirect: exchangeable calcium promoted the accumulation of humus.
3. It was assumed that the effect of the clay fraction of soil on the formation of water-stable aggregates 10-0.25 mm. in diameter was negative, but it was inhibited in the horizons under study by the presence of humus.
4. The influence of the soil formation process on the structure of the humus-eluvial horizons of Podzolic and Gray Forest soils was manifest in the form of aggregates and to some extent in their sizes. The content of structural and aggregate separates of various sizes in the horizons varied considerably. Wetting of the humus-eluvial horizons of gray forest soils promoted a decrease in the content of large aggregates.

Scripta Technica Inc., 1000 Vermont Ave. N.W., Washington, D.C., 20005

121. Ballantyne, A. K., and Clayton, J. S. THE RELATIONSHIP OF EXCHANGEABLE CATIONS IN THE B HORIZONS TO THE FIELD SEPARATIONS OF SOLONETZIC AND CHERNOZEMIC SOILS. Canad. J. Soil Sci. 44(1): 43-49. 1964.

Exchangeable cation data were presented for 97 Solonetzic and 131 Chernozemic B horizons from profiles sampled on morphological characteristics, by the Saskatchewan Soil Survey. The average exchangeable sodium percentage in the B horizons of the Calcareous, Orthic, and Eluviated Chernozems was 0.95, 1.3, and 2.6; and in the B_n horizons of the Solonetz, Solodized Solonetz, and Solod was 4.5, 9.4, and 4.0.

Using the chemical criteria accepted by the National Soil Survey Committee of Canada for a n horizon (over 12 percent exchangeable sodium or more exchangeable sodium plus magnesium than calcium) only 28, 74, and 41 percent of the Solonetz, Solodized Solonetz, and Solod, as classified in the field, would remain in the Solonetzic Order. On the basis of exchangeable cations, 4 percent of the Orthic and 20 percent of the Eluviated Chernozems would fall within the Solonetzic Order because of high exchangeable magnesium.

It was proposed that a Solonetzic B horizon on the basis of chemistry be one that contains more than 4 percent exchangeable sodium and has a ratio of exchangeable calcium to sodium of 10 or less, in order to exclude Chernozemic soils with high exchangeable magnesium from the Solonetzic Order.

Res. Sta., Canada Dept. Agr., Saskatoon, Saskatchewan, Canada.

122. Kaye, C. BOULDER TRAIN OF SILICIFIED PALEOZOIC WOOD, SOUTHEASTERN MASSACHUSETTS. Geol. Soc. Amer. B. 75(3): 233-236. 1964.

Pebbles of silicified gymnospermous wood occur widely in the drift of southeastern Massachusetts. The bedrock source of the wood was shown to be tuffaceous beds that apparently overlie older granite in the Middleboro-Plympton area, Massachusetts, and are at the base of the Carboniferous rocks of the Narragansett Basin. A second center of distribution of the wood may lie offshore, north of Cape Cod. It was estimated that many thousands of large logs were broken up and carried away from the outcrop by Pleistocene ice sheets in the production of the boulder train.

U.S. Geol. Survey, Dept. Int., Boston, Mass.

123. Malde, H. E. PATTERNED GROUND IN THE WESTERN SNAKE RIVER PLAIN, IDAHO, AND ITS POSSIBLE COLD-CLIMATE ORIGIN. Geol. Soc. Amer. B. 75(3): 191-207. 1964.

A distinctive sorted pattern of soil mounds and stone pavement, which resembles patterned ground of cold regions, is widely distributed in southern Idaho on gravel fans, basaltic lava flows, and marginal rocky colluvium, as well as on some outcrops of lake beds and welded tuff.

Soil mounds in flat areas are closely packed, monotonously uniform circular heaps 50-60 feet across and 3 feet high, on slopes they are elliptical and lie in rows along paths of soil that trend downhill. Each mound is composed of a lenshaped cap of silt about 18 inches thick, abruptly underlain by 1-2 feet of brown clay that rests on siliceous hardpan.

Stone pavement that surrounds mounds in rocky places consists of a shallow layer of well-sorted stones derived from underlying parent rocks. It is marked by vertical sorting (large stones on smaller ones), by tabular stones turned on edge (commonly parallel to the pavement border), and by numerous broken stones--all encrusted with lichens.

The pattern varies with local slope. A net pattern, consisting of pavement woven between equally spaced mounds of flat terrain, gradually lengthens into a striped pattern, consisting of alternate rows of soil and pavement on hillsides. Striped patterns are first perceptible on grades of 3 percent, dominant on grades of 10 percent, and still recognizable on grades of 50 percent.

The patterned ground could have formed under a periglacial climate during the late Pleistocene when mass-wasting was presumably favored by freeze and thaw of saturated soil, but this origin is based only on analogy with patterns in cold regions, and the evidence of age is inconclusive. If this opinion is correct, the cold aspect of the Pleistocene extended several hundred miles farther south than has been generally assumed.

U.S. Geol. Survey, Dept. Int., Denver, Colo.

124. Hoffmeister, J. E., and Multer, H. G. GROWTH-RATE ESTIMATES OF A PLEISTOCENE CORAL REEF OF FLORIDA. Geol. Soc. Amer. B. 75(4): 353-357. 1964.

The time needed for the formation of a 7-foot thick vertical section of the Pleistocene Key Largo coral reef of the Florida Keys was estimated on the basis of the growth rate of the important reef-building coral species Monastrea annularis, to be between 250 and 500 years.

U. Rochester, Rochester, N.Y.

125. Evernden, J. F., Savage, D. E., Curtis, G. H., and James, G. T. POTASSIUM-ARGON DATES AND THE CENOZOIC MAMMALIAN CHRONOLOGY OF NORTH AMERICA. Amer. J. Sci. 262: 145-198. 1964.

The existence in North America of volcanic tuffs of Tertiary age whose stratigraphic age is well controlled by fossil mammals affords the means for critical testing of the K/A method in the range 1 to 70 million years and for critical evaluation of previously defined Mammal Ages. The K/A technique as now used has such precision that discordant results between K/A ages and Mammal Age designations must lie either in the geologic history of the samples or in the Mammal Age criteria. The samples used ranged in age from Early Puercan through Blancan to interglacial. Sanidines, biotites, and basalts were used for dating. Critical evaluation of each basalt sample by thin-section examination was absolutely essential.

The K/A ages and the Mammal Age designations were in essentially perfect agreement, thus substantiating the usefulness of the K/A technique throughout the Tertiary and supporting the conclusion that the defined Mammal Ages have true evolutionary significance. Correlations with European Ages and Pacific Coast foraminiferal Ages through both K/A and fossil criteria were internally consistent. A detailed timescale of the Tertiary based upon an Age breakdown was given. Due to the disputes about the proper Epoch-Age correlations, Epoch boundaries were deliberately exluded from the diagram. The confusion caused by present definitions of the Plio-Pleistocene boundary was illustrated by use of K/A dates.

U. Calif., Berkeley, Calif.

126. Donath, F. A., and Parker, R. B. FOLDS AND FOLDING. Geol. Soc. Amer. B. 75(1): 45-46. 1964.

The geometry and the internal features of folds reflect the mechanisms that produce folds. The close relation between mechanism and resultant structure permits fold characteristics to be used in determining the mechanisms. The mechanisms can be used to infer general environmental conditions under which deformation has occurred.

The relative ductilities and the nature of inherent anisotropy (primarily layering and interlayer cohesion) in the involved rocks determine which mechanism of folding will operate. Flexural mechanisms are dependent on the presence of mechanical anisotropy; passive mechanisms operate when anisotropy is absent or ineffective. As the ductilities of the involved rocks increase, the effect of layering in the folding process decreases.

Flexural folding represents a true bending of layers and can be produced by slip between layers, flexural slip, or by flow within layers, flexural flow. Passive folding reflects relative displacements of layer boundaries by flow or slip across the boundaries; the layering does not control the configuration of the deformed mass--it merely reflects the deformation. Passive mechanisms are designated passive flow and passive slip. Where irregular flow occurs within and across layers, certain layers are flexed in response to passive behavior in the associated rocks. This gradational mechanism is called quasi-flexural folding; the geometry and more obvious features of the fold are flexural in general aspect, but the overall behavior is predominantly passive. Individual fold mechanisms are not mutually exclusive but may operate singly or in combination to produce folds.

Columbia U., New York, N.Y.

127. Dodd, J. D., Rennie, D. A., and Coupland, R. T. THE NATURE AND DISTRIBUTION OF SALTS IN UNCULTIVATED SALINE SOILS IN SASKATCHEWAN. Canad. J. Soil Sci. 44(2): 165-175. 1964.

Investigations were undertaken to ascertain the relative abundance of various salts in uncultivated saline soils occurring in southern Saskatchewan. Sampling sites were selected within areas dominated by various native plant species and groups of species. One hundred and nineteen saline profiles in the Brown, Dark Brown, and Black soil zones were studied and classified into five sub-group profile types, which were usually associated in a catenary sequence.

The Saline Gleyed Regosol occupied the central portion of depressional area, followed successively by the Saline Gleysol, and the Saline Meadow, with the Saline Calcareous Chernozem occupying the perimeter of the depression and the Saline Rego Chernozem being transitional to upland soil. Nine species which commonly form extensive stands were associated in their distribution with these subgroup profile types.

Analytical data from saturation extracts of samples taken from the 0-7, 6-12, 12-24, and 24-36 in. depths were discussed with reference to concentration and composition. With one exception, all samples showed a preponderance of sodium and magnesium ions. Soluble sodium percentages in extreme cases exceeded 90 percent. Sulphates, chlorides, and bicarbonates were present in practically all samples. While sulphate was the predominant anion, significant quantities of chlorides and bicarbonates were present in all profiles.

U. Saskatchewan, Saskatoon, Saskatchewan, Canada.

128. Harpstead, M., and Rust, R. H. A PEDOLOGICAL CHARACTERIZATION OF FIVE PROFILES IN GRAY WOODED SOILS AREA OF MINNESOTA. Soil Sci. Soc. Amer. Proc. 28(1): 113-118. 1964.

Five soil profiles from the Gray Wooded soils area of Minnesota were investigated in the field for morphological characteristics and in the laboratory for physical, chemical, and mineralogical properties. This Gray Wooded soils area has a cool humid climate, mixed coniferous and deciduous vegetation, and the profiles studied were developed in well-drained glacial till of late Wisconsin age.

X-ray diffraction patterns revealed a wide variety of clay minerals. In most cases, Ca^{2+} was the dominant ion on the exchange complex. The upper portion of the B horizon was the most acid part of the profiles with pH values as low as 4.7. Various types of clay films, found to be well developed in the argillic B horizons, were investigated in thin-sections. The degradation of peds in the A and B horizon was also studied with thin-sections.

A classification of these soils according to the 7th Approximation was suggested.

Tables and profile descriptions.

Wis. State Col., Stevens Poins, Wis.

129. Patnode, H. W., and Hodgson, R. A. THREE DIMENSIONAL GEOLOGIC MAPS. Amer. J. Sci. 262: 274-278. 1964.

Geologic maps in three dimensions show the actual spatial relations and distribution of rock units, thus greatly increasing the viewers comprehension of these features. They may be prepared as relief models or as stereo-pairs for conventional stereo-viewing. Examples of three dimensional maps of several types were described and illustrated.

Gulf Res. and Develop. Co., Pittsburg, Pa.

130. Fly, C. L., and Romine, D. S. DISTRIBUTION PATTERNS OF THE WELD-RAGO SOIL ASSOCIATION IN RELATION TO RESEARCH PLANNING AND INTERPRETATION. Soil Sci. Soc. Amer. Proc. 28(1): 125-130. 1964.

Criteria for predicting applicability to other soils of research results obtained from key or benchmark soils was given. Soil-water-plant growth relations which affect yields under different levels of management were evaluated at Akron, Colo. Under 46 years of uniform management, wheat production levels varied from 73 to 120 among eight soil types identified in a 25-acre test field formerly mapped as one soil type. Soil differences induced wider variations under uniform treatment than did different treatments on a single soil type. When the detail of delineation and characterization of soils is comparable to the detail of the research plot layout, existing research fields and plot data may be used to associate soil qualities with response to treatment. The reliability of application of research findings to other areas will depend on adequate characterization and evaluation of the soil in each plot.

Jr. Author, Agr. Expt. Sta., Colo. State U., Fort Collins, Colo.

EROSION CONTROL

Erosion Equation

131. Chepil, W. S., Siddoway, F. H., and Armbrust, D. V. IN THE GREAT PLAINS: PREVAILING WIND EROSION DIRECTION. J. Soil and Water Conserv. 19(2): 67-70. 1964.

Throughout most of the Great Plains, some definite prevailing wind erosion direction exists. This means that throughout most of the region it is definitely advantageous to lay field strips, to plant shelterbelts, to practice emergency erosion-reducing tillage, and to plant crops as nearly as possible at right angles to the prevailing wind erosion direction.

The prevailing wind erosion direction for the different parts of the Great Plains and the relative degree of certainty that the aforementioned practices should be carried out as nearly as possible at right angles to that direction were determined.

Information on the prevailing wind erosion direction should aid in determining the unsheltered distance, L, (in the wind erosion equation) used to determine wind erodibility of farm fields and, conversely, to determine width of fields or field strips and intervals between wind barriers needed to control wind erosion at different locations in the Great Plains.

F. H. Siddoway, SWCRD, ARS, USDA, Sidney, Mont., 59270

Wind and Water Erosion

SEE ALSO 1, 17, 138, 178, 180, 215.

132. Hornbeck, J. W., and Reinhart, K. G. WATER QUALITY AND SOIL EROSION AS AFFECTED BY LOGGING IN STEEP TERRAIN. J. Soil and Water Conserv. 19(1): 23-27. 1964.

The influence of different forestry practices on streamflow has been investigated since 1951 on five forested watersheds, 38 to 96 acres in area, on the Fernow Experimental Forest in the mountains of West Virginia. The effects of cutting and logging practices on water quality were reported.

Practices ranged from a commercial clearcutting without regard to water values or the future value of the property, to an intensive selection cutting with careful planning and careful logging. The experiment demonstrated that excessive damage to water quality can be avoided even when logging on steep terrain. Measured maximum turbidities of stream were 56,000 p.p.m. on the commercial clearcut area and only 25 p.p.m. on the intensive selection cut watershed. Most of the damage to water quality occurred during and immediately after logging.

Recommended forestry practices discussed included: Planning of the logging operation; proper location, drainage, and grade of skidroads; and timely completion of the operation in any specific area. In most respects, practices recommended for watershed protection also contribute to the overall efficiency of the logging operation.

Northern Forest Expt. Sta., FS, USDA, Fernow Expt. Forest, Parsons, W. Va.

133. Webber, L. R. SOIL PHYSICAL PROPERTIES AND EROSION CONTROL. J. Soil & Water Conserv. 19(1): 28-30. 1964.

Measurement of soil and water losses on plots on a 7-percent slope near Guelph, Canada, for 10 consecutive years were given. The principal soil treatments were continuous cropping with corn and with hay and rotation cropping with and without the practice of strip cropping. Major soil losses were confined to two treatments; continuous corn and oats in rotation, both planted with the slope. Erosion on the continuous corn plot resulted in significant decreases in organic matter content, aggregate stability, and the volume of air-filled pores at low tensions of water. Minor soil losses under corn in rotation and planted with the slope resulted in small changes in these properties.

The soil and water losses under oats in a rotation of corn-oats-hay-hay planted with the slope were attributed to a ridge-rolling practice used in establishing grasses and legumes.

These results indicated that: (1) A crop rotation including a hay or pasture crop was important in maintaining the organic matter content and the stability of soil aggregates; and (2) a significant erosion hazard was associated with ridge-rolling with the slope to aid the establishment of small seeds.

Ontario Agr. Col., Guelph, Ontario, Canada.

134. Peterson, J. B. THE RELATION OF SOIL FERTILITY TO SOIL EROSION. J. Soil and Water Conserv. 19(1): 15-19. 1964.

A review of the literature on the relation of soil fertility to soil erosion was given.

The author summarized that there are highly significant inverse correlations between crop-yield levels and soil and water losses from sloping lands. These have been taken into account by Wischmeier in developing the widely used universal soil-loss equation. Although the beneficial effects of high fertility in reducing erosion through the effects of more rapid early growth, more lush canopy, enlarged root systems, more organic residues for plowing under or leaving on the surface, more active soil flora and fauna, higher soil organic matter content, and better tilth are real and obvious, not many experiments have been designed to give adequate definitive limits to the effects of different levels of fertility. The indirect effects of high soil fertility in reducing soil and water losses were evident in the data.

Purdue U., Lafayette, Ind.

135. Valentine, K. A., and Norris, J. J. A COMPARATIVE STUDY OF SOILS OF SELECTED CREOSOTEBUSH SITES IN SOUTHERN NEW MEXICO. J. Range Mangt. 17(1): 23-32. 1964.

Physical and chemical properties of soils of four selected creosotebush sites in southern New Mexico were studied. The soils remained capable of supporting establishment and growth of the climax dominant grasses, although deterioration through erosion, and in one case loss of structure, had occurred.

One site appeared to have lost soil to the extent that production capacity for the test species had been significantly reduced. At the same site, continuing erosion threatened to further reduce soil productivity by exposure of an underlying high gypsum substratum. Range management practices consisting of proper grazing management and control of creosotebush to preserve and improve these range areas were strongly indicated.

N. Mex. Agr. Expt. Sta., University Park, N. Mex.

136. Wittmuss, H. D., and Swanson, N. P. TILL-PLANTED CORN REDUCES SOIL LOSSES.
Agr. Engin. 45(5): 256-257. $0.50. 1964.

Although the till-plant system of minimum tillage was developed primarily to lower operating costs, studies also showed significant reductions in runoff and erosion.

Under the till-plant system, the soil surface is protected by plant residue until planting time, when a strip 16 in. wide over the old row is tilled and the seed planted in one operation.

The differences in soil losses between conventional and till-plant methods for different simulated rainfall intensities at a time when the water erosion potential was highest were studied.

Total infiltration and soil losses on the test plots for two different storms from the June and July test were reported in the table. The first storm, 60-min. duration and a $2\frac{1}{2}$ i.p.h. intensity, can be expected once in 10 years in central Nebraska. The second storm, of 18-min. duration and a 4 i.p.h. intensity storms expected once a year in the area.

Total infiltration on individual plots ranged from 0.8 to 1.2 for the 60-min. storm and from 0.2 to 0.6 in. for the 18-min. storm. No consistent differences were observed in infiltration between tillage treatments. Differences in storm intensity did not materially affect the infiltration rate.

TABLE SOIL LOSS AND TOTAL INFILTRATION DATA FOR BRIDGEPORT VERY FINE SANDY LOAM, NORTH PLATTE, NEBRASKA, JUNE AND JULY 1961

Plot no.	Tillage practice	Soil loss, tons per acre 60-minute $2\frac{1}{2}$-iph storm	Soil loss, tons per acre 18 minute 4-iph storm	Total infiltration per storm, inches 60-minute $2\frac{1}{2}$-iph storm	Total infiltration per storm, inches 18 minute 4-iph storm
1	Till-planted	3.4	3.0	0.75	0.30
2	Till-planted	3.4	3.5	1.05	0.35
	Average	3.4	3.2	0.90	0.32
3	Non-tilled	1.2	0.4	0.95	0.55
4	Non-tilled	0.4	0.4	1.20	0.30
	Average	0.8	0.4	1.08	0.42
5	Conventional tillage	10.3	5.3	1.20	0.25
6	Conventional tillage	11.0	10.7	1.05	0.40
	Average	10.7	8.0	1.10	0.32

Soil losses of less than 1 ton per acre per erosion-producing storm may be expected from the time the corn plants provide a canopy cover until the residue cover is again tilled the following spring. The bare surface soil on conventionally tilled fields is exposed to the impact of raindrops for a 10-week period. Only a strip of surface soil 12 to 16 in. wide over the row is exposed for a 6-week period on the till-planted fields.

On an annual basis, 1.3 excessive storms may be expected in central Nebraska on till-planted fields and 1.7 excessive storms on conventionally tilled fields during the respective periods the soil surfaces are exposed to the impact of raindrops before a canopy cover develops.

The productivity of Bridgeport vfsl can be expected to decline if annual soil losses exceed 5 tons per acre per year. Using a storm of $2\frac{1}{2}$ i.p.h. intensity for a 60-min. duration as a basic excessive storm, the average annual soil losses for each of the two tillage practices can be predicted. Soil losses of 4 tons per acre per year (3.2 tons per acre times 1.3 excessive storms) can be expected on the till-planted plots as compared to expected soil losses of 14 tons per acre per year (8.0 tons per acre times 1.7 excessive storms) on the conventionally tilled plots.

Under the conditions existing in the study, corn could be grown continuously with some row slope under the till-plant system. Contour farming with terraces or rotation with sod-forming crops would be required under the same conditions for a conventionally tilled field to reduce soil losses to less than 5 tons per acre per year.

Complete report for sale by ASAE, 420 Main St., St. Joseph, Mo.

137. Fryrear, D. W. ANNUAL CROPS AS WIND BARRIERS. Trans. ASAE 6(4): 340-342, 352. 1963.

Annual crop barriers can reduce surface wind velocity and thereby protect the soil surface from wind erosion. Although dense barriers are susceptible to damage from drifting snow deposited within the barriers, they offer more protection than porous barriers. Sudangrass and grain sorghum proved to be the best barriers tested. Future research may show taller crops such as kenaf or hybrid broomcorn to be more resistant to weathering and more effective in controlling wind erosion.

The barrier effectiveness index method of evaluating barrier influence was very satisfactory in making statistical comparisons of barrier influence as measured 1 ft. above the soil surface. The index should be useful in evaluating other barrier, shelterbelt, and windbreak influences.

The density meter worked very well for determining relative barrier density. The principle involved in its design may be adapted to future barrier, shelterbelt, and windbreak research.

Blackland Conserv. Expt. Sta., SWCRD, ARS, USDA, Tempe, Tex., 76502

Strip cropping

SEE 137, 180.

Terracing

SEE ALSO 136, 180, 230.

138. Jacobson, P. NEW METHODS OF BENCH TERRACING STEEP SLOPES. Trans. ASAE 6(3): 257-258, 261. 1963.

Bench terracing has been suggested as a measure for controlling erosion in the deep loess areas. The soils are generally deep and of fairly uniform texture throughout the profile. They will permit cuts of 2 or 3 ft. without exposing infertile subsoil of inferior texture. Cuts of this depth will be required on the steeper slopes if they are to be benched. The benches will be on a slope which by natural process becomes stable (4 percent or flatter). The soils will absorb and store much of the moisture that falls. However, since much of the loess area is characterized by steep slopes, the cost of developing the benches has not been considred economical.

Since erosion and farming operations are tending to bench land, why not let the natural process do the job? The stage can be set by correct spacing and proper alignment. Then nature over a period of time will bench the area as shown in Fig. 1.

Observations on terraces show they are benching. In the West Tarkio project near Shenandoah, Iowa, terraces built 20 to 30 years ago are almost completely benched.

A set of terraces was laid out and constructed in the fall of 1961 on slopes ranging from 14 to 16 percent in Crawford, County, Iowa. The terraces were mainly constructed from the downhill side. The downhill slope was made steep and will be left in permanent grass.

The spacing was adjusted so that, when the benching process is completed, the rows on the bench are a multiple which can be handled by modern farm equipment. The downhill slope of the terrace was made to average 3 feet horizonal to 1 foot vertical. In construction, the downhill slope of the terrace was varied between $2\frac{1}{2}$ to 1 and $3\frac{1}{2}$ to 1 to provide uniform width of farmed area and thus avoid point rows.

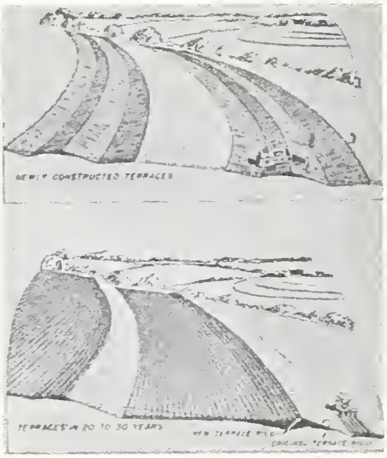

FIG. 1 Process of benching which will be accomplished by equipment operation and natural erosion.

SCS, USDA, Des Moines, Iowa.

Critical Areas

139. Beer, C. E., and Johnson, H. P. FACTORS IN GULLY GROWTH IN THE DEEP LOESS AREA OF WESTERN IOWA. Trans. ASAE 6(3): 237-240. 1963.

A functional relationship which described the gully development phenomena in western Iowa was given based on a historical approach where all variables were evaluated from the past growth of gullies. Steer Creek Watershed, a gullied area in Harrison County, Iowa, was used. The rates of gullying were determined with the use of controlled aerial flights, supplemented with a topographic survey which was made on the watershed 20 years ago. The hydrologic and watershed factors which were postulated to effect gullying were evaluated for the same period as for the gully growth.

The major emphasis was directed to the evaluation of the lateral gully development since 1938. The gully, hydrologic, and watershed data were programmed for the IBM 650 computer. From the programmed data, prediction equations based on two models were obtained for the change in gully surface area. These models were the characteristic linear model and a logarithmic model where the independent factors were multiplied in the prediction equation. Although different hydrologic, gully, and watershed variables and combinations of these variables were used, the prediction equation for change in gully surface area which most nearly represented the gully development phenomena was one of the logarithmic models.

Iowa State U., Ames, Iowa.

140 Cook, D. B., and Smith, R. H. PLANTING AN ADVERSE SITE IN NEW YORK--II. J. Forestry 62(3): 161-162. 1964.

In 1941, six conifer species were planted in small blocks on a recently cultivated, poorly drained, exposed hilltop site in southwestern Alban, County, N.Y., to determine whether any or all would be suitable to reforest such adverse sites.

All species suffered at first from frost heaving and strong winds. After 21 growing seasons, white cedar had grown too slowly to produce a closed stand. White spruce, while resistant to glaze storms and heavy, wet snow was only beginning to dominate the site. Jack pine had formed a thin, crooked-stemmed stand, still being damaged by winter storms; its volunteer seedlings were vigorous and straight-stemmed. Red pine had grown poorly on this deficiently-drained site; nearby plantations on better-drained sites were satisfactory. European larch showed poor initial survival, was later damaged by ice and snow, but the remaining, undamaged trees had grown satisfactorily. Japanese larch suffered moderate damage from ice and snow but had produced the best stand of all, while its numerous volunteer seedlings were growing vigorously.

N.Y. State Conserv. Dept., Albany, N.Y.

141. Smith, W. L. SELECTION NO. 3 A GOOD TURF GRASS FOR EROSION-PRONE AREAS. Land and Water Contract. 6(2): 13. 1964.

A first cousin of Coastal bermudagrass, known as Selection No. 3, promises to be a good turf grass to stabilize erosion-prone areas.

Selection No. 3 is a selection of the same cross that produced Coastal bermudagrass at the Georgia Coastal Experiment Station. Several selections were made and numbered, Selection (Coastal) No. 35, Selection (Midland) No. 13, and Selection (Suwanee) No. 99. Selection No. 3 remained unnamed and was discarded in favor of the others.

Selection No. 3 is a vigorous hybrid somewhat darker green in color than Coastal. It has shorter internodes and produces a denser sod cover than the other hybrids tried. These characteristics make it a good grass to stabilize steep erosive areas.

The Soil Conservation Service planted two floodwater-retarding structures in 1963 to test the grass as a slope stabilizer. One structure was in a mixed Blackland area, located near Terrell, Tex. The other structure was in an erosive sandyland area near Dyemound, Tex. The results were gratifying and other trials are planned.

The advantages of Selection No. 3 over common bermudagrass for stabilization of slopes were due to its hybrid vigor and increased drought resistance. Forage or top growth was equal to or greater than Coastal.

Work in Georgia indicated that Selection No. 3 was less palatable than Coastal bermudagrass. Since the use of the grass on the structures was primarily for erosion control, the lower palatability was considered an advantage.

SCS, USDA, Denton, Tex.

142. Meiners, R. G. STRIP MINING LEGISLATION. Nat. Resources J. 3(3): 442-469. 1964.

A history of and a review of strip mining legislation in the different states were given.

U. Pittsburg, Pittsburg, Pa.

SOIL MANAGEMENT

Cropping Practices

SEE ALSO 112, 136, 153, 173, 183, 187, 188, 191, 197, 198, 218, 219, 220, 224, 226, 251, 256.

143. Dubetz, S., and Hill, K. W. EFFECT OF IRRIGATED CROP ROTATIONS ON YIELD AND SOIL FERTILITY. Canad. J. Plant Sci. 44(2): 139-144. 1964.

Crop yields and soil analyses were compared from three 4-year, two 5-year, and two 7-year rotations. The yields of potatoes from the seven rotations were not significantly different. Barley was grown in six rotations and the yields from these were not significantly different. The yield of sugar beets from the one rotation that did not receive any manure was significantly lower than those from the other six rotations. In the rotation in which sweet corn followed sweet clover green manure, the yields were significantly lower than those from the other six rotations, where the corn followed sugar beets. This presumably was a result of the phytotoxicity of the decomposing clover.

Good husbandry practices such as manure and fertilizer application evidently overshadow the effect of rotations on the yields of irrigated crops. The organic matter and nitrogen of the surface 6 in. of soil were maintained in the rotations that included 3 years of alfalfa or alfalfa-brome mixture. These soil constituents were not maintained with a single year of alfalfa or with a partial green manure crop.

Res. Sta., Canada Dept. Agr., Lethbridge, Alberta, Canada.

144. Lehane, J. J., Warder, F. G., and Staple, W. J. DECLINE OF WHEAT YIELDS AND DEPLETION OF SOME NUTRIENTS ON A LOAM SOIL DURING A 36-YEAR PERIOD. Canad. J. Soil Sci. 44(1): 50-55. 1964.

Wheat was grown in outdoor tanks 15 in. in diameter and 5 ft. deep for a period of 36 years. The extent that two crop rotations and two levels of available water influenced the yield and nutrient depletion of a loam soil was shown. The average yield of wheat receiving added water was nearly twice that of crops receiving rainfall only, and the yields of crops receiving added water were eventually limited by the lack of available plant nutrients.

There was no marked difference in the organic carbon and nitrogen content or the pH of the different treatments. There was a high accumulation of nitrate nitrogen in the lower depths of the soil in a fallow-wheat rotation receiving rainfall only. Significant differences were found in bicarbonate soluble phosphorus at nearly all depths between the different treatments. Summerfallowing apparently maintained the soluble phosphorus at a higher level. The soluble phosphorus content of the soil from the added water treatment at the end of the 36-year period was lower than that considered sufficient for maximum yields.

Expt. Farm, Canada Dept. Agr., Swift Current, Saskatchewan, Canada.

145. Welbank, P. J. TOXIN PRODUCTION DURING DECAY OF AGROPYRON REPENS (COUCH GRASS) AND OTHER SPECIES. Weed Res. 3(3): 205-214. 1963.

Inhibition of extension growth of rape seedlings was used to measure toxin production from plant material incubated with soil at 20° C. Waterlogging was most important for toxin production from Agropyron repens rhizomes. It made little difference whether fresh, frozen, or dried rhizome pieces were used. Toxicity was still increasing after 33 days' incubation. A. repens, Agrostis tenuis, Lolium multiflorum, and Medicago lupulina all produced similar amounts of toxin per unit weight of dry matter in waterlogged mixtures with a sandy loam (pH 5.7) or a clay soil (pH 7.5). A medium loan (pH 7.2), which gave appreciable toxicity when incubated alone, produced slightly more toxicity from Agrostis tenuis and Lolium multiflorum than did the other soils, otherwise soil type had little effect. The results do not support the view that Agropyron repens was exceptional in producing toxin.

Rothamsted Expt. Sta., Harpenden, Herts, England.

146. Gressel, J. B., and Holm, L. G. CHEMICAL INHIBITION OF CROP GERMINATION BY WEED SEEDS AND THE NATURE OF INHIBITION BY ABUTILON THEOPHRASTI. Weed Res. 4(1): 44-53. 1964.

Aqueous extracts of the ground seeds of 13 weed species were assayed for their ability to inhibit the germination on filter paper of 8 crop species. All of the extracts delayed germination of at least some of the crop species. Germination of some crop species was delayed when the crop seeds were surrounded by weed seeds on filter paper. The seeds of Abutilon theophrasti were inhibitory to tomato (Lycopersicum esculentum) germinated in sterile and non-sterile soil in the laboratory. The inhibition of germination was apparent under conditions which excluded light, water, and minerals as factors in the competition. Chemical studies indicated that the inhibition by Abutilon seeds was due to free amino acids emanating from the seeds.

U. Wis., Madison 5, Wis.

147. Raju, M. V. S., Steeves, T. A., and Coupland, R. T. ON THE REGENERATION OF ROOT FRAGMENTS OF LEAFY SPURGE (EUPHORBIA ESULA L.) Weed Res. 4(1): 2-11. 1964.

The roots of leafy spurge (Euphorbia esula L.) normally produce shoot buds abundantly near the soil surface but with decreasing frequency at increasing depths.

Fragments of roots collected from various depths in the soil were planted in shallow flats in a glasshouse. Root fragments from all depths down to 2.8 m. did not differ appreciably in regenerative capacity and this capacity was not dependent upon the presence of preformed shoot buds. Root fragments were collected from the same stand throughout the growing season, and regenerative capacity was found to be lowest in June at the time of maximum flowering. The implications of these findings were discussed in relation to the control.

U. Saskatchewan, Saskatoon, Saskatchewan, Canada.

148. Robocker, W. C., and Kerr, H. D. CHARACTERISTICS AND HERBICIDAL CONTROL OF FLAT PEA. Weeds 12(1): 40-42. 1964.

Flat pea (Lathyrus sylvestris L.), previously investigated as a forage plant in the United States, is a perennial legume with undesirable qualities of low palatability, difficulty of establishment, and a toxic principle. Characteristically aggressive and tolerant to a wide range of growth conditions, it is a potentially serious weed in its area of adaptation. A related species, everlasting pea (L. latifolius L.) has similar characteristics. A 2 lb./A. rate of 2,4-D, 2,4,5-T, or 2,3,6-TBA followed by 2 lb./A. of silvex a year later gave complete control of established plants and seedings of flat pea.

CRD, ARS, USDA, Pullman, Wash.

149. Allred, K. R., and Tingey, D. C. GERMINATION AND SPRING EMERGENCE OF DODDER AS INFLUENCED BY TEMPERATURE. Weeds 12(1): 45-48. 1964.

Seeds of largeseed dodder (Cuscuta indecora, Choisy), field dodder (Cuscuta campestris, Yuncker), and small-seeded dodder (Cuscuta approximata, Bab.) were studied on the basis of: (1) Germination at different temperatures; and (2) spring emergence of seedlings as related to soil temperature.

Small-seeded dodder germinated at 35° to 45° F. with maximum germination at 60° F. Largeseed dodder germinated very little and field dodder not at all below 50° F. They germinated best at 60° F. and above.

Dodder seeds were planted outside at different depths in a sandy loam soil during the autums of 2 years. Daily counts on seedling emergence during the spring showed that small-seeded dodder was first to germinate, at a soil temperature of 39° F., largeseed dodder emerged from 7 to 10 days later at a soil temperature of 51° F., and field dodder emerged 2 to 4 days still later. Very few seedlings of the small-seeded dodder emerged after mid-May, but largeseed and field dodders continued to emerge throughout the summer.

Utah State U., Logan, Utah.

150. Davis, D. E., and Funderburk, H. H., Jr. ERADICATION OF KUDZU. Weeds 12(1): 62-63. 1964.

Thirteen treatments during a 5-year period with a 1:1 mixture of the propylene glycol butyl ether esters of 2,4-D and 2,4,5-T were required to eradicate an established stand of kudzu (Pueraria lobata (Willd.) Ohwi.).

Auburn U., Agr. Expt. Sta., Auburn, Ala.

151. Roche, B. F., Jr., and Muzik, T. J. ECOLOGICAL AND PHYSIOLOGICAL STUDY OF ECHINOCHLOA CRUSGALLI (L.) BEAUV. AND THE RESPONSE OF ITS BIOTYPES TO SODIUM 2,2-DICHLOROPROPIONATE. Agron. J. 56(2): 155-160. 1964

Echinochloa crusgalli, known locally as barnyardgrass and watergrass, has spread over much of the irrigated land of the Pacific Northwest. The plant seems well suited to the conditions normally created in the production of low-growing row crops (beans, sugar beets, green peas, and melons). The competition for water, light, and nutrients resulting from the rapid growth of barnyardgrass during the period of establishment of these crop plants coupled with the large number of seeds frequently produced makes it an economic liability. Dalapon has been used, but its record for barnyardgrass kills has not been consistent.

A study was made to determine if biotypes of barnyardgrass existed in the south-central portion of Washington state and if so, to check the biotypes for possible differences in resistance to dalapon, to determine the viability of the seed, its length of life in the soil, and time and rate of germination as conditioned by light, moisture, and temperature. The authors concluded that:

1. Barnyardgrass seeds germinated over a wide range of termperatures but germinated best at an alternating temperature of 20 to 30° C. Seeds varied in color and weight, depending upon the position on the inflorescence and stage of maturity at the death of the parent plant. These seeds differed in germination requirements.
2. Barnyardgrass emerged from depths of 6 inches but not from 8 inches.

3. Variations within the species were established as consistent when plant selections were grown in a uniform environment; therefore, biotypes do exist.
4. Significantly different responses to dalapon occurred among the 12 selections tested.
5. The susceptibility of barnyardgrass to dalapon varied with the stage of development of the plant. The single leaf stage was significantly more susceptible than were the more mature stages of the same biotype.

Wash. Agr. Expt. Sta., Pullman, Wash.

152. Holloway, J. K. HOST SPECIFICITY OF A PHYTOPHAGOUS INSECT. Weeds 12(1): 25-27. 1964.

The use of insects in the biological control of weeds necessitates that these insects have very restricted host ranges. Specialized insects boring in stems or living in seed pods have adaptations which obligate them to their host plant. However, the leaf-feeding beetle, (Chrysolina quadrigemina Suffrian,) imported for the control of St. Johnswort (Klamath weed) (Hypericum perforatum L.) through its feeding habits, tropistic responses, and synchronization of its life history to the growth phases of the plant has shown that it is restricted to its preferred host plant.

ERD, ARS, USDA, Albany, Calif.

Crop Residue Management

SEE ALSO 144, 164, 178, 179, 180, 306.

153. Bovey, R. W., and Fenster, C. R. AERIAL APPLICATION OF HERBICIDES ON FALLOW LAND. Weeds 12(2): 117-119. 1964.

Volunteer wheat and downy brome (Bromus tectorum L.) were consistently controlled by aerial application of granular atrazine without supplemental tillage. Injury to winter wheat seeded has occurred in the fall 13 and 14 months after application of atrazine. Plots aerially treated with 2 lb./A. atrazine produced yields comparable to the check but plots treated with 4 lb./A. atrazine produced no wheat. Use of persistent herbicides for chemical fallow must be restricted until further knowledge is obtained.

U. Nebr., Lincoln, Nebr.

Tillage

SEE ALSO 14, 61, 131, 136, 180, 216, 217.

154. Larson, W. E. SOIL PARAMETERS FOR EVALUATING TILLAGE NEEDS AND OPERATIONS. Soil Sci. Soc. Amer. Proc. 28(1): 118-122. 1964.

Estimated critial limits of selected soil parameters for evaluating tillage requirements for corn in the water management (interrow) zone and seedling environment (row) zone were presented. Suggested parameters for corn in the western Cornbelt for the row zone include: Soil temperature; secondary aggregate size; bulk density; and volume of the zone. For the interrow zone, the parameters include: Depression storage; plow layer storage; and/or surface mulch or surface microrelief. The research basis for the selection of the critical limits and soil parameters was discussed. This approach can be used to evaluate tillage needs for other crops.

SWCRD, ARS, USDA, Iowa State U., Ames, Iowa.

SEE ALSO 36, 41, 42, 75, 78, 79, 80, 81, 82, 86, 88, 89, 92, 96, 97, 100, 104, 105, 107, 110, 111, 112, 113, 114, 115, 116, 117, 134, 143, 171, 176, 178, 181, 184, 185, 201, 202, 210, 255, 256, 290, 294, 307, 308, 309, 310, 313.

155. Gasser, J. K. R. FERTILIZER UREA. World Crops 16(4): 25-31. 1964.

The work on urea as a fertilizer has shown three main agricultural problems: (1) The presence of biuret as an impurity; (2) loss of ammonia from urea applied to soils; and (3) damage to the germination of seed and to the early growth of crops.

Biuret should not be a problem now because urea can be made containing so little that it is not toxic when the urea is used as a fertilizer. Urea containing much biuret should be rejected for use as fertilizer rather than try to find ways of applying it to minimize damage. For applying to the soil, the biuret content should not exceed 1 percent, so that even the most sensitive crops are not damaged. For foliar sprays, urea must contain less biuret and where repeated spraying of tree crops is done, care should be taken to avoid building up biuret contents of leaves and shoots. As biuret is metabolished slowly, a large single dose of biuret may be expected to damage permanently the leaves to which it is applied and repeated small doses may eventually lead to damage.

The problems of loss of ammonia from urea and damage to germination both stem from its hydrolysis in soil giving free ammonia. Preventing both loss and damage depends on decreasing free ammonia present. This may be done either by mixing the urea with the soil or by mixing it with an acid material such as superphosphate. An alternative method of preventing the damage to germination and early growth of cereal crops is to drill the fertilizer at the side of the seed and separate by about an inch of soil.

Urea nitrate and urea phosphate are both well defined easily produced compounds and merit further consideration as fertilizers. Urea nitrate is slightly water-soluble and may store better than either urea or ammonium nitrate, both of which deliquesce. Both urea nitrate and ammonium nitrate contain about 34 percent N, compared with 45 percent N in fertilizer grade urea. Urea nitrate has not been tested as a fertilizer but warrants investigation. Urea phosphate containing 17.7 percent N and 45.0 percent P_2O_5 (19.6 percent P) has the same N:P ratio as di-ammonium phosphate. The values of urea nitrate and urea phosphate for incorporating in mixed fertilizers are unknown.

Urea is useful for preparing liquid fertilizers because it is very soluble in water and can safely be mixed with some other fertilizer salts. In particular its property of forming a eutectic solution with ammonium nitrate enables a liquid nitrogen fertilizer to be made containing 34 percent N by weight.

An advantage of urea for foliar application is that it is not corrosive so that special equipment is not necessary to apply the sprays. It is compatible with many herbicides and fungicides, and being non-ionic causes less osmotic (salt) damage to plants. Urea is valuable for tree crops that can absorb it through a large leaf area and translocate or store it for future growth.

Urea is the cheapest source of solid nitrogen fertilizer per pound of N sold on the international market, and is easily manufactured from readily available raw materials. For use as solid fertilizers, prilled and granulated urea are much better than crystalline urea, and resin-coated urea is very good although more expensive. Where the agricultural difficulties from losses of ammonia and damage to crops were overcome, experimental results indicated that urea was as good a source of fertilizer-N as ammonium sulphate and ammonium nitrate. All possible approaches appear to merit further consideration in order to achieve the full potential of urea as a fertilizer.

Bibliography.

Rothamsted Expt. Sta., Harpenden, Herts., England.

156. Romsdal, S. D., and Schmehl, W. R. EFFECT OF WATER SOLUBILITY AND GRANULE SIZE OF PHOSPHORUS FERTILIZERS ON ALFALFA GROWN IN A CALCAREIOUS SOIL. Agron. J. 56(2): 184-186. 1964.

Yield and P uptake were increased by increasing the water solubility or decreasing the granule size of fertilizers. There was a water-solubility x granule-size interaction but solubility had little influence on yields with the 40-mesh or smaller materials. The effectiveness of fertilizers having 47 percent or more solubility tended to be independent of size. The influence of solubility on yield and P uptake was reduced with successive cuttings or by incubating the soil-fertilizer system before cropping.

Colo. State U., Fort Collins, Colo.

157. Terman, G. L., Moreno, E. C., and Osborn, G. ACIDULATION OF PHOSPHATE ROCK IN SOIL. Soil Sci. Soc. Amer. Proc. 28(1): 104-107. 1964.

Sulfur, H_2SO_4, H-resin, and 20 percent superphosphate were compared as acidulants for phosphate rock (PR) as the source of P for corn grown on Hartsells fsl (ph 5.2 and 6.3) in greeenhouse pot experiments. Effectiveness of granular fertilizers for supplying P to the crops decreased as follows: PR + superphosphate > PR + H-resin > PR + S > PR alone. An intermediate size of granules of PR + S + soil was more effective than either coarser or finer material. H-resin added to spots of PR in the soil was much more effective in solubilizing P than equivalent amounts of acid as H_2SO_4 or S. Acidulating PR in the soil with H-resin or H_2SO_4 was considerably less effective for solubilizing PR than acidulation prior to application.

TVA, Wilson Dam, Ala.

158. Hamilton, H. A., and Lathwell, D. J. INVESTIGATION OF SOME FACTORS IMPORTANT IN DIFFERENTIAL CROP RESPONSE TO DIAMMONIUM AND MONOCALCIUM PHOSPHATES. Canad. J. Soil Sci. 44(1): 14-21. 1964.

Under greenhouse conditions, potential oat yields with diammonium phosphate (DP) and monocalcium phosphate monohydrate (MCP) were compared when increasing rates of P_2O_5 were used.

Oat yields were similar for the two phosphatic sources when mixed with the soil. With band placement of MCP at 400 lb. P_2O_5 per acre, the highest yield of oats was realized. This yield was not significantly greater than that obtained when 800 lb. P_2O_5 per acre as DP was mixed with the soil; but was significantly greater than that obtained when MCP at 800 lb. P_2O_5 per acre was mixed with the soil.

By banding DP at 400 lb. P_2O_5 per acre, the yields for each of two successive oat crops were no better than those obtained when 50 lb. P_2O_5 was mixed with the soil. On the other hand, for an alfalfa crop succeeding oats, DP banded at 400 lb. P_2O_5 per acre resulted in yields which were not significantly different from the maximum yield obtained by mixing DP with the soil.

Irrespective of phosphate source, there were decreased amounts of exchangeable ammonium in soil after 2 weeks of crop growth, with increasing rates of P_2O_5. With DP as a source of nitrogen and phosphorus, the exchangeable ammonium in soil at the end of 4 and 6½ weeks was significantly greater than the amounts found with the use of MCP + $(NH_4)_2SO_4$.

There were no significant differences between MCP and its soil reaction product relative to oat yields obtained with band placement; but when mixed with the soil, the MCP-soil reaction products resulted in significantly greater yields. In the case of DP, and MCP + $(NH_4)_2SO_4$, their soil reaction products gave similar yields to those obtained with the pure materials irrespective of method of placement.

Expt. Farm, Canada Dept. Agr., Kapuskasing, Ontario, Canada.

159. Boatwright, G. O., and Ferguson, H. YOUNG WHEAT PLANTS FINICKY ABOUT USING PHOSPHORUS. Mont. Farmer Stockman. 51(12): 43. March 5, 1964.

Recent greenhouse experiments with spring wheat have shed light on the reasons why "proper" phosphorus placement is important.

When phosphorus was not available to the plants during the first 2 weeks of growth, vegetative growth and grain yields were materially reduced. This was true in spite of liberal applications of phosphorus after this period. Unless adequate phosphorus was available for at least the first 5 weeks of growth, both vegetative growth and grain yields were reduced.

By the time plants have attained 25 percent of their total dry weight, they will have accumulated as much as 75 percent of their total phosphorus. It appears that phosphorus is a major factor in the development of tillers and secondary roots, since neither was produced in these greenhouse studies until phosphorus was added

A major factor controlling the availability of fertilizer phosphorous to plants is soil moisture. Using radioactive phosphorus, it was shown that the plants could not absorb phosphorus from a dry soil. Moreover, after wetting a dry soil that contained adequate amounts of phosphorus, appreciable time elapsed before the phosphorus was taken up by the plants.

Only small amounts of phosphorus were absorbed from soils that had been wet less than 3 days. Thus, fertilizer phosphorus should be placed near the seed in order to insure early contact by seeding roots and in a soil zone that is wet and is likely to remain wet for a considerable length of time. Since spring and summer precipitation often occurs as light showers and is often rapidly lost by evaporation, one cannot depend on this moisture to make phosphorus fertilizer placed at a shallow depth available to plants for an extended period of time.

SWCRD, ARS, USDA, Bozeman, Mont., 59715

160. Basaraba, J. MINERALIZATION OF UREA-FORMALDEHYDE COMPOUNDS AT DIFFERENT pH LEVELS AND TEMPERATURES. Canad. J. Soil Sci. 44(1): 131-136. 1964.

Mineralization of urea-form fertilizer materials was studied in soils at two different pH levels and five different temperatures.

The nitrogenous materials decomposed very slowly but progressively throughout the incubation period of 14 weeks, and nitrate was the main product formed. The rates of nitrate production from the urea-form compounds were, in general, from 2 to 5 percent higher in soil with an initial pH 5.7 than in soil having an initial pH 7.0. At the end of the incubation period, the quantities of nitrate formed from the two urea-form compounds were about equal, amounting to 20, 28, 40, 50 and 58 percent of the total nitrogen added at 10, 15, 20, 25, and 30° C. respectively.

The laboratory results suggested that the urea-form materials studied could be of only limited value to plants if applied to soils with temperatures below 15° C. during the growing season.

Acadia, U., Wolfville, Nova Scotia, Canada.

161. Widdowson, F. V., Penny, A., and Williams, R. J. B. SIDE-PLACING UREA AND OTHER NITROGEN FERTILIZERS FOR SPRING BARLEY. J. Agr. Sci. 62(1): 73-82. 1964.

Laboratory experiments compared alternative ways of placing urea for wheat. Urea greatly increased the pH in the seed-row; placed in contact with seeds, it killed many plants, but did not when placed 1 in. to the side of the seed.

A combine-drill was modified so that, by simple adjustments, fertilizers could be placed in contact with the seed, or at 1 in. to the side of the seed, or broadcast over the seed-bed.

Fifteen experiments with spring barley and one with spring wheat, made from 1960-62, compared yields from urea with yields from ammonium sulphate; calcium nitrate and sodium nitrate were tested in seven and six experiments, respectively. Each fertilizer was compared broadcast over the seed-bed, combine-drilled, or placed 1 in. to the side of the seed, at 0.35 or 0.70 cwt. N/A. Eleven experiments were on soils that contained much calcium carbonate and five on other soils. The author concluded that:

1. Urea and ammonium sulphate gave similar yields when boradcast, but combine-drilled urea killed some plants and decreased yield whereas combine-drilled ammonium sulphate was safe. Urea placed 1 in. to the side of the seed was safer; it gave larger yields than side-placed annomium sulphate. Urea and ammonium sulphate yielded similarly on soils with much calcium carbonate, so both fertilizers probably lost similar amounts of free ammonia.
2. Calcium nitrate and sodium nitrate gave larger yields than ammonium sulphate when broadcast, but only slightly larger yields when combine-drilled or side-placed. In two experiments in 1962, sodium nitrate gave considerably more grain than did ammonium sulphate.
3. The experiments were on fields where cereals had been grown often; 0.70 cwt. N/A. was fully justified.
4. Each year the mean nitrogen content of barley grain from plots without fertilizer N was rather more than 1.6 percent. Ammonium sulphate increased grain percentage N and N uptake least, so it was the least efficient N fertilizer on these soils. At 0.70 cwt. N/A., the most nitrogen was recovered from calcium or from sodium nitrate.

Rothamsted Expt. Sta., Rothamsted, Herts, England.

162. Mason, J. L., and Miltimore, J. E. EFFECT OF NITROGEN CONTENT OF BEARDLESS WHEATGRASS ON YIELD RESPONSE TO NITROGEN FERTILIZATION. J. Range Mangt. 17(3): 145-147. 1964.

The nitrogen content of range grass was shown to be related to yield response to nitrogen fertilizer. A comprehensive yield response experiment on beardless wheatgrass (Agropyron inerme) gave the basic relationship between nitrogen content and yield. The linear regression equation was LOG (100-y) = -0.9073 (percent N) + 2.3670 where y is yield expressed as a percent of maximum yield obtained in the experiment. A series of four test experiments were used to evaluate the relationship. The yield of the check plots expressed as percent maximum was plotted against nitrogen content. The points from all four experiments were within the 95 percent confidence belt of the regression line. The data suggest that nitrogen analysis of range grass could be used as a measure of the fertilizer response to be expected. Grass was harvested at the seed-set stage of maturity.

Canada Agr. Res. Sta., Summerland, British Columbia, Canada.

163. Driel, W. Van. THE EFFECT OF IRON ETHYLENEDIAMINETETRAACETIC ACID ON THE GROWTH AND METABOLISM OF TOMATO PLANTS IN WATER CULTURE. Plant and Soil 20(1): 85-104. 1964.

Tomato plants were grown in nutrient culture either continuously or discontinuously treated with $FeSO_4$ or with Fe-EDTA. $FeSO_4$ rapidly gave a precipitate of $Fe_2O_3NH_2O$ but remained available to the plants. Fe absorbed from Fe-EDTA in the nutrient medium was less effective in inducing tomato plant growth than iron supplied as ferrous sulphate. This could not be explained in terms of luxury consumption or by phosphate-induced internal iron immobilization.

Plants grown continuously with Fe-EDTA as an iron source showed consistently higher peroxidase and catalase activities. Chlorotic plants treated for a few days with $FeSO_4$ exhibited mostly equal or higher enzyme activities than those treated with Fe-EDTA. The ratio of green and yellow chloroplast pigments was constant under all the tested levels of iron nutrition.

Although there were significant differences in iron utilization, enzyme activities, and some symptoms of slightly modified growth, the main conclusion was that, under these strictly comparable conditions, plant metabolism was modified considerably by the use of the synthetic iron chelates.

Bibliography of 55 papgers.

Inst. Soil Fertility, Groningen, Netherlands.

164. Corder, G., and Atkinson, W. O. TOBACCO STALKS AND STEMS FERTILITY VALUE AND USE. U. Ky. Coop. Ext. Serv. Leaflet 269, 6 pp. 1964.

Tobacco stalks produced annually in Kentucky contain about 9.8 million pounds of nitrogen, 932,000 pounds of phosphorus, and 13 million pounds of potassium. Equal amounts of these three plant nutrients bought in commercial fertilizers in 1963 would have cost more than $2 million. The value of tobacco stalks as soil-building and soil-conserving material is even greater when you consider their organic matter and secondary trace elements.

Table 1. - Average Composition and Value of Burley Tobacco Stalks and Stems as a Fertilizer Material

	Total Pounds per Ton					Value** per Ton
	N	P*	K*	Ca	Mg	
Stalks	56	5	75	36	5	$12.50
Stems	50	5	145	70	8	$15.70

* Phosphorus (P) can be convered to P_2O_5 by multiplying the above figure by 2.29 and potassium (K) can be converted to K_2O by multiplying by 1.2

** Calculated on the assumption that nitrogen (N) retails for 12¢ per pound, phosphorus (P) for 19¢ and potassium (K) for 6¢ per pound. Calcium and magnesium are not included in the value.

Since dark tobacco, both fire- and air-cured, was not fertilized at as high rates as burley tobacco, the nutrient content of the stalks and stems was somewhat lower.

Table 2. - The Average Amounts of Various Nutrients in Burley Stalks and Stems That Are Available the First Year of Application

Material	Pounds available per Ton				
	N	P*	K*	Ca	Mg
Stalks	30	4	62	15	3
Stems	27	4	116	50	6

* Phosphorus (P) can be converted to P_2O_5 by multiplying the above figure by 2.29 and potassium (K) can be converted to K_2O by multiplying by 1.2

About 61 percent of the nitrogen, 38 percent of the phosphorus, 83 percent of the potassium, and 41 percent of the organic matter were lost from tobacco stalks when they were piled outside the barn and exposed to rainfall during the winter months.

The following cautions were given: (1) Tobacco stems should not be used on tobacco land unless they are sterilized at the re-dryer; (2) if a mosaic susceptible variety of tobacco is being grown, the stalks should not be used on tobacco beds or fields; and (3) stalks from black shank infested fields should not be used on tobacco land, but may be used on other field crop and pasture land provided water from these fields does not drain on to tobacco land.

Agr. Ext. Serv., Col. Agr. and Home Econ., U. Ky., Lexington, Ky.

165. Hart, S. A. THIN SPREADING OF SLURRIED MANURES. Trans. ASAE 7(1): 22-25. 1964.

One of the most vexing problems of concentrated livestock farming is getting rid of the manure. Copious quantities are produced; cattle defecate about 1 cubic foot of material per animal per day. This manure is a prime breeding medium for flies and may pose serious odor and sanitation hazards and usually is removed from the animal confinement area at frequent intervals. Generally it cannot be applied to cropland immediately because the specialized livestock farmer may not have cropland and because fertilizing is a seasonal rather than a daily operation.

The manure from modern dairy, beef, and swine feedlots, and from caged poultry houses, is pure manure--it contains no bedding or litter. It averages 25 to 40 percent solids (60 to 75 percent water) on a wet-weight basis.

When manure is fluidized to 10 to 20 percent solids, it forms a slurry the consistency of cake or pancake batter that can be uniformly and thinly discharged by pumping from a tank truck or trailer. How thick a layer of manure could be spread, day after day, layer upon layer, and still prevent fly breeding or other sanitation problems was studied. This specific approach would be useful where space for a manure-drying yard is at a premium and where one expects to build up a thick mat of manure which later can be scraped up and utilized. Modifications for different climates and for different ultimate uses of the manure were considered.

The technique, results, and conclusions were summarized as follows:

1. There were mechanical problems in manure fluidization and in spreading.
2. Six 12-ft. by 22-ft. chicken manure plots, and 6 identical dairy manure plots were each dosed with 47 cumulative layers of the appropriate manure slurry on a 5-time-per week schedule. The thickness of each layer of slurry applied to each plot was constant, but the different plots received different thicknesses, ranging from 1/25 to 3/10 in. The manure slurries averaged 19.8 percent total solids for the chicken and 13.7 percent for the dairy.
3. The solids content in the plot should be above 85 percent to prevent fly breeding.
4. During midsummer there was no fly breeding in the cumulative mat with application rates of 1/6 to 1/5 in. per day 5 days per week. The maximum thickness with absence of fly larvae decreased as summer progressed, but layers 1/25 in. thick were satisfactory late in the year.
5. A significant amount of organic matter was lost during drying and storage; this loss was related to the moisture content of the plot. One-half or more of the nitrogen originally present in the manure was lost.
6. The land area needed for cumulative layering was not large--less than 200 sq. ft. per cow and 1 sq. ft. per chicken. Slurry manures can be spread noncumulatively in summer rainfall areas. Subsoil injection of manure slurries offers definite promise.
7. Odors can and do occur in manure thin spreading, but can be minimized by thin layering of fresh manure only, complete drying, or chemicals.

U. Calif., Davis, Calif.

Salinity and Alkali Problems

SEE ALSO 45, 52, 118, 121, 127, 135, 254.

166. Francois, L. E., and Bernstein, L. SALT TOLERANCE OF SAFFLOWER. Agron. J. 56(1): 38-40. 1964.

Four safflower varieties (N-10, U.S. 10, Gila, and 41191197) were grown in artifically salinized plots to determine the effects of saline conditions on the yield and quality of seed produced.

Safflower is highly salt-tolerant. An EC_e of 7 millimhos per centimeter reduced yield to 10 percent, and an EC_e of 11 millimhos per centimeter reduced yield by 20 to 25 percent. These yield reductions were caused by a decrease in the number of flowering heads and the yield of seed per head, the latter factor being affected by seed weight and not be seed number.

Safflower appeared to be only half as salt-tolerant during germination as during later stages of growth. An EC_e of 7 millimhos per centimeter doubled emergence time, whereas an EC_e of 14 or 15 millimhos per centimeter was estimated to reduce growth and seed yield by 50 percent.

U.S. Salinity Lab., SWCRD, ARS, USDA, Riverside, Calif., 92502

167. Lunin, J., Gallatin, M. H., and Batchelder, A. R. INTERACTIVE EFFECTS OF BASE SATURATION AND EXCHANGEABLE SODIUM ON THE GROWTH AND CATION COMPOSITION OF BEANS. Soil Sci. 97(1): 25-33. 1964.

Green beans were grown on a Bladen sil treated with $CaCO_3$, $MgCO_3$, and $NaHCO_3$ to give three levels or classes of base saturation and four levels of exchangeable Na. Two groups of these treatments were prepared: one in which the exchangeable

Ca + Mg varied within a base-saturation level and one in which the exchangeable Ca + Mg was constant.

Yields decreased with increasing exchangeable Na, with the greatest decreases occurring in the group in which Ca + Mg was constant. Yields of both pods and tops were higher for the medium level of base saturation than for the high level. Highly significant yield interactions were obtained between base saturation and exchangeable Na effects for both groups.

The Ca and Mg contents of the bean tops were closely related to the composition of the substrate. The Na content of the plant tops was unaffected by increases in Na concentration of the substrate, except at the high levels where the content in the plant rose sharply. Increasing Na in the substrate increased the K content in the plant.

It was suggested that more attention be given to characterizing Na in relation to the exchangeable cation composition of the soil, taking into consideration the pH dependency of the exchange capacity of certain soils.

SWCRD, ARS, USDA, Norfolk, Va., 23500

168. Krupkin, P. I. MOVEMENT OF SALT SOLUTIONS IN SOILS AND SOIL MATERIALS. Soviet Soil Sci. 6: 567-574. June, 1963.

Monoliths of strongly leached fine-textured chernozems were treated for 6 months and 4 years with single- and mixed-salt solutions. A number of regularities was found.

1. As a result of the interaction between the soil profile and salt solutions, the lower horizons become solonetzic; the intensity of this process differed under the action of various salts and salt mixtures; maximum solonetzization was produced by an Na_2CO_3 solution, the minimum by NaCl + Na_2SO_4, and intermediate by NaCl + Na_2SO_4 + Na_2CO_3.
2. The degree of soil solonetzization was determined not only by the amount of adsorbed sodium, but also by the anionic part of the salt from which sodium entered the adsorption complex. A sodium carbonate solution had a more active effect than a neutral sodium salt.
3. Under treatment with sodium carbonate solutions, only the lowermost part of the profile became solonetzic (not more than 20-25 cm.). This was accompanied by the formation of calcium carbonate and increase in total alkalinity, degree of peptization exchange capacity, and soil dispersion. Sodium carbonate moved only a very short distance along the soil profile. The formation of solonetzes under the influence of sodium carbonate was possible only if sodium carbonate formed in the given soil layer.
4. Calcium and magnesium chlorides, formed as a result of exchange reactions between the sodium from salt solutions and the calcium and magnesium of the adsorption complex, moved up the profile together with neutral sodium salts. Chlorides moved more rapidly than sulfates because of the new formation of gypsum and its precipitation in the middle of the profile.
5. The distribution of salts after treatment of monoliths with a mixture of neutral and hydrolytic alkali sodium salts was similar to that under the influence of both salts separately.
6. During prolonged soil salinization, accompanied by partial temporary desalinization (rain, meltwater), calcium chloride gradually transformed into gypsum and precipitated all the depth of wetting. The upper horizons become ever more enriched with sodium salts. The latter entered in the adsorption complex.

Scripta Technica Inc., 1000 Vermont Ave. N.W., Washington, D.C., 20005

169. Fanning, C. D., and Lyles, L. SALT CONCENTRATION OF RAINFALL AND SHALLOW GROUNDWATER ACROSS THE LOWER RIO GRANDE VALLEY. J. Geophysical Res. 69(4): 599-604. 1964.

A 1-year study was made of the salt concentrations of rainfall and the static water table across the lower Rio Grande Valley of Texas. A linear decrease in salt concentration was observed with logarithmic distance inland. The concentrations of individual ions determined, except calcium, follow the logarithmic relationship. The salt content of the shallow, saline ground water also decreased with distance inland. The decline in ground water salt concentration with distance was more rapid than the decline in annual salt deposition by rainfall.

SWCRD, ARS, USDA, Madison, Wis., 53706

Cover Crops and Green Manure Crops

SEE 14, 143.

Climatic Influences

SEE ALSO 11, 17, 20, 24, 28, 29, 34, 37, 41, 43, 48, 56, 62, 63, 65, 67, 68, 72, 85, 93, 109, 110, 117, 128, 131, 136, 140, 144, 146, 149, 151, 158, 160, 169, 174, 175, 178, 181, 183, 201, 215, 216, 222, 288, 295, 300, 305.

170. Schleusener, R. A. WEATHER MODIFICATION. J. Hydraul, Div., ASCE 90 (HY 1): 57-75. Jan. 1964.

A review was given of the current status of attempts to increase precipitation by artificial means. Major research efforts are being made on this problem, both in the United States and in foreign countries. A review of the evidence currently available tends to substantiate the conclusions of the President's Advisory Committee on Weather Control for accepting the reality of precipitation increase resulting from cloud seeding in "cold-cloud" orographic cases. Some evidence suggests that, in some cases, a precipitation decrease may have resulted from cloud seeding. New techniques are available for detection of silver iodide in precipitation. Some evidence exists for a "carry-over" effect from seeding with silver iodide, subsequent to termination of the seeding operation.

Colo. State U., Fort Collins, Colo.

171. Ferguson, W. S. EFFECT OF RAINFALL ON PLANT RESPONSE TO PHOSPHORUS. Canad. J. Soil Sci. 44(2): 180-187. 1964.

Measurements of the phosphorus content of wheat at intervals during the growing season (1958-62) indicated that percentage phosphorus in the growing plant was closely related to the amount of rainfall and to frequency of irrigation. The percentage phosphorus decreased during dry years or when irrigation was applied infrequently. This was attributed to the vertical stratification of available phosphorus in the soil since moisure use data indicated that a larger proportion of the active root zone of the crop was in the phosphorus-deficient subsoil during dry periods. This relationship between percentage plant phosphorus and moisure supply was found with fertilized and unfertilized crops alike. However, frequent watering prior to the 5-leaf stage increased the difference in percentage plant phosphorus between fertilized and unfertilized wheat.

Yearly variation (1936-52) in the degree of plant response to phosphorus on a Chernozemic soil was high. The degree of plant response was positively correlated with May rainfall and negatively correlated with June rainfall. It was proposed that this relationship existed because during years of above-normal May rainfall, phosphorus fertilizer was more efficiently utilized and with below-normal June rainfall a higher proportion of root development occurred in the phosphorus-deficient subsoil which increased phosphorus stress in the crop.

Expt. Farm, Canada Dept. Agr., Brandon, Manitoba, Canada.

172. Rubin, J., Steinhardt, R., and Reiniger, P. SOIL WATER RELATIONS DURING RAIN INFILTRATION: II. MOISTURE CONTENT PROFILES DURING RAINS OF LOW INTENSITIES. Soil Sci. Soc. Amer. Proc. 28(1): 1-5. 1964.

During transient-state infiltration of steady, low intensity rain into laboratory soil columns, moisture contents at increasing soil depths tended with time to approach a constant level. This level, as well as the observed rates of wetting-front advance, were higher in cases of more intense rain. For the conditions studied, soil moisture contents and wetting-front advance rates associated with ponded-water infiltration were generally considerably higher than those of rain infiltration profiles.

The differences between the observed and the theoretically predicted rain infiltration profile data were insignificant for rains of low intensity but significant for those of higher intensity.

U.S. Geol. Survey, Menlo Park, Calif.

173. Johnson, W. C. SOME OBSERVATIONS ON THE CONTRIBUTION OF AN INCH OF SEEDING-TIME SOIL MOISTURE TO WHEAT YIELD IN THE GREAT PLAINS. Agron. J. 56(1): 29-35. 1964.

The average contribution to yield of an inch increment of stored moisture was estimated at 2.44 and 2.74 bushels per acre for spring and winter wheat, respectively. Allowing for side effects of management practice other than soil moisture reduced the estimate for early-plowed continuous spring wheat and fallowed spring wheat to 1.40 and 1.48 bushels per acre, respectively. The corresponding estimates for winter wheat were 2.48 and 1.99 bushels per acre.

Great Plains Field Sta., SWCRD, ARS, USDA, Bushland, Tex., 79012

174. Holt, R. F., Timmons, D. R., Voorhees, W. B., and Van Doren, C. A. IMPORTANCE OF STORED SOIL MOISTURE TO THE GROWTH OF CORN IN THE DRY TO MOIST SUBHUMID CLIMATIC ZONE. Agron. J. 56(1): 82-85. 1964.

Soil moisture recharge data, moisture use patterns, and soil moisture-corn yield relationships point to the critical dependence of corn on stored soil moisture in western Minnesota and eastern South Dakota. The authors concluded that:

1. Available soil moisture at planting varied from 1 to 12 inches for 75 locations over a 6-year period. About one-third of these locations had less than 6 inches of stored soil moisture and this is the minimum desired soil moisture reserve necessary to produce about 70 bushels of corn per acre with normal precipitation.

2. Corn yields were related to stored soil moisture at planting for 2 of the 3 years studied.
3. The effect of stored soil moisture on corn yields was minimized by above-normal rainfall during the critical growth period, particularly between July 1 and August 15. Yields were more dependent on available soil moisture at planting when rainfall during the critical growth period was below normal.
4. Determination of stored soil moisture at planting may provide an aid toward better management practices for corn production.

SWCRD, ARS, USDA, Morris, Minn., 56267

175. Yao, A. Y. M., and Shaw, R. H. EFFECT OF PLANT POPULATION AND PLANTING PATTERN OF CORN ON THE DISTRIBUTION OF NET RADIATION. Agron. J. 46(2): 165-169. 1964.

Experiments were conducted at Ames, Iowa, in 1960-61 to measure radiation interception and water use by corn plants with different plant populations and planting patterns.

Net radiation was measured 1 meter above the crop surface and 6 inches above the soil surface in six treatments in 1960 and four treatments in 1961.

Net radiation at 1 meter above the crop surface was usually higher on 42-inch rows than 21-inch rows and was higher on single plantings than on double plantings. This was believed due to a difference in the albedo (whiteness) of a crop surface and a moist soil surface. The difference in net radiation at 1 meter above the crop surface between treatments was high at the beginning of the season and gradually decreased as the season progressed.

Net radiation at 6 inches above the soil surface was higher on the 42-inch rows than the 21-inch rows and was higher on single plantings than on double-plantings. Net radiation was high on all treatments during the early season at 6 inches above the soil surface, decreased rapidly with time until the silking stage was reached and then remained relatively constant throughout the rest of the season.

The average Ratio of Radiation (R_n) at the Ground (G) to Radiation 1 Meter Above the Crop Surface (T) for double plantings was generally lower than for single plantings. With the same population, the closer the row spacing the lower was the ratio. At the beginning of the season, the ratio of $R_n(G)/R_n(T)$ was near unity because of very small crop cover. As the season progressed, size and leaf area of the corn plant increased and the average value of $R_n(G)/R_n(T)$ decreased until the silking stage. The ratio then remained constant. The maximum value of $R_n(G)/R_n(T)$ occurred during the early morning at 5-6 A.M., and the late afternoon, at about 5-6 P.M.

The maximum soil evaporation estimated from net radiation data indicated that the 21-inch single planting could evaporate up to 3 inches of water; the 21-inch double planting, 2 inches of water; the 42-inch single planting, 4.2 inches of water; and the 42-inch double planting, 2.8 inches of water for the period July 2-September 30.

Res. Meteorologist, Foreign Area Sect., Off. Climatology, U.S. Weather Bur., Suitland, Md.

Surface Soil Removal

176. Lutwick, L. E., and Hobbs, E. H. RELATIVE PRODUCTIVITY OF SOIL HORIZONS, SINGLY AND IN MIXTURE. Canad. J. Soil Sci. 44(1): 145-150. 1964.

Alfalfa was grown in the greenhouse on the various horizons, singly and in mixture, on two southern Alberta soil profiles. Manure and phosphate fertilizer treatments were superimposed.

Highest yields of alfalfa and highest uptakes of phosphorus by the alfalfa were obtained where the crop was grown on soil containing A horizon material. Responses to fertilizer treatments were greatest on those soils containing no A horizon material. The yields obtained on the fertilized subsoils were approximately equal to those obtained on the unfertilized topsoil, but in no case did the fertilized subsoil produce as much alfalfa as the fertilized topsoil.

Res. Sta., Dept. Agr., Lethbridge, Alberta, Canada.

Mulching

SEE ALSO 59, 185.

177. Hermann, R. K. PAPER MULCH FOR REFORESTATION IN SOUTHWESTERN OREGON. J. Forestry 62(2): 98-101. 1964.

A survey was made in western Oregon to determine the effect of paper mulch on first-year survival of 2-0 Douglas-fir seedlings in 1961. Nine planting sites, representing three different climatic and topographic conditions, were selected. Two hundred and fifty seedlings with mulch and an equal number of seedlings without mulch on each planting site were marked in spring and their survival was checked in the middle and at the end of the growing season. The survey showed that: (1) Survival of seedlings was increased significantly by paper mulch on each planting site; (2) survival with mulch was up to five times higher than that of seedlings without mulch; (3) degree of success with mulch appeared to be related to amount of precipitation and time of application, but not to steepness of site; (4) paper lasted through the growing season, but began to disintegrate rapidly with the onset of fall rains.

Results of checks made in fall of 1963 still reflected the effects of mulching. Survival after three growing seasons averaged 55.6 percent for seedlings with mulch, compared to 12.3 without mulch. Differences were most pronounced in districts with driest summers. At Medford, 41 percent of seedlings with mulch survived, but only 12 percent without mulch. The corresponding figures at Roseburg were 59 percent and 0 percent.

Forest Res. Lab., Oreg. State U., Corvallis, Oreg.

178. Taylor, R. E., Hays, O. E., Bay, C. E., and Dixon, R. M. CORN STOVER MULCH FOR CONTROL OF RUNOFF AND EROSION ON LAND PLANTED TO CORN AFTER CORN. Soil Sci. Soc. Amer. Proc. 28(1): 123-125. 1964.

A mulch of corn stover and barnyard manure has given excellent control of soil and water losses from corn after corn on a steeply sloping deep loess soil. During 9 years of measurement in Wisconsin, losses of soil and water from corn after corn with a mulch were less than from corn or oats without mulch in a corn-oats-hay rotation and were about equal to the losses from the meadow in the rotation. Corn yields averaged 3 bushels more from the corn after corn than from the corn in the corn-oats-hay rotation, with the corn residues removed.

SWCRD, ARS, USDA, Lancaster, Wis., 53813

179. Anderson, D. T., and Russell, G. C. EFFECTS OF VARIOUS QUANTITIES OF STRAW MULCH ON THE GROWTH AND YIELD OF SPRING AND WINTER WHEAT. Canad. J. Soil Sci. 44(1): 109-118. 1964.

The effects of applying a wheat straw mulch at various rates to a trash-free summerfallow field immediately after seeding spring and winter wheat were studied for 9 years. Rates of 4,000 and 5,000 lb. or more per acre significantly depressed mean yields of spring and winter wheat, respectively. Straw at rates of 4,000 to 5,000 lb. completely shaded the soil surface when spread uniformly. Higher rates delayed maturity up to 4 to 6 days, shortened height of plants, occasionally lowered nitrate production, and had a negligible effect on plant population and percentage protein of the grain. Each 1,000-lb. increment of bright straw depressed the late-morning temperature in the 4- to 8-in. depth of soil by an average value of 0.51° F. during the early growth period. The depression increased with the season to a value of 0.65° F. by mid-June and then decreased to a value of 0.25° F. by mid-July, when the crop, in the headed-out stage, almost completely shaded the soil surface.

A quantity of mulch up to 4,000 lb./A. can be used without deleterious effects on the crop. Quantities of 4,000 lb. or more should be managed so that the soil temperature depression associated with complete shading of the soil is avoided.

Res. Sta., Canada Dept. Agr., Lethbridge, Alberta, Canada.

180. Meyer, L. D., and Mannering, J. V. CROP RESIDUES AS SURFACE MULCHES FOR CONTROLLING EROSION ON SLOPING LAND UNDER INTENSIVE CROPPING. Trans. ASAE 6(4): 322-323, 327. 1963.

Crop residues have an important potential for better erosion control on intensively cropped, sloping soils. Intensive cropping usually creates a serious erosion hazard on sloping fields. Yet intensive cropping is economically desirable or necessary on sloping fields of many farms. To resolve this dilemma, new erosion-control techniques or more acceptable ways of using proven techniques must be developed. These include: Supporting conservation practices such as terracing and strip cropping; erosion-reducing tillage practices, such as minimum and strip tillage; and better uses of crop residues. The better use of crop residues was considered in this review of the literature.

Crop residues have been used extensively as: Surface mulches for horticultural purposes; wind-erosion control; and erosion control on steep embankments such as road cuts and dams. Their value for water-erosion control on farm fields has been generally recognized, but adverse crop environmental effects and other problems have discouraged their widespread use in this way. The benefits from surface residues for erosion control are determined by the method of handling, type of residue, and amount of residue.

The following example of the way plant residues can be used to maximum advantage for control of erosion throughout the year was given: (1) Spring--Allow plants or plant residues from prior crops to remain on the soil surface until planting time. Plow and plant crops with minimum tillage to increase infiltration and thereby reduce erosion, or plant in a mulch tillage seedbed. (2) Summer--Cultivate row crops as required to control weeds or to eliminate crust. Apply a manure mulch or plant material from adjacent strips after final cultivation. And (3) Fall--Shred cornstalks shortly after harvest, or plant fall crop in a mulch tillage seedbed. Apply manure as mulch to fields without other cover.

Although these or comparable steps may not all be practicable, use of any of them can help reduce erosion under intensive cropping. These practices also generally improve immediate crop yields and progressively improve the soil condition.

SWCRD, ARS, USDA, Lafayette, Ind., 47907

Pasture and Haylands

SEE ALSO 39, 41, 42, 43, 97, 100, 106, 107, 108, 116, 133, 137, 141, 143, 158, 162, 176, 178, 200, 201, 202, 251, 294, 302, 303.

181. Van Riper, G. E. INFLUENCE OF SOIL MOISTURE ON THE HERBAGE OF TWO LEGUMES AND THREE GRASSES AS RELATED TO DRY MATTER YIELDS, CRUDE PROTEIN, AND BOTANICAL COMPOSITION. Agron. J. 56(1): 45-50. 1965.

Alfalfa, birdsfoot trefoil, smooth bromegrass, orchardgrass, and intermediate wheatgrass were sown in pure stands and in legume-grass associations. Relative differences in soil moisture use, herbage dry matter yields, crude protein, and botanical composition under a three cutting management system were investigated during a relatively wet year and a relatively dry year.

Alfalfa and alfalfa-grass associations effectively used the available soil moisture during both years. The effective use of soil moisture by alfalfa and alfalfa-grass mixtures was reflected in dry matter yields and soil moisture use for each year. Alfalfa and alfalfa-grass associations exhausted most of the available soil water at the lower depths during 1961, when precipitation during the growing season was below normal.

Orchardgrass, grown in pure stands, was unable to effectively use the available soil water at deeper soil depths. During 1961, bromegrass used significantly more water from the third, fourth, and fifth foot of soil depth than orchardgrass. Dry matter yields of orchardgrass were lower than either bromegrass or intermediate wheatgrass, during the first cutting of both years.

Species were insignificantly different in water use within each foot of soil depth during both years. Grasses grown without nitrogen fertilizer during 1960 and all forages except birdsfoot trefoil in 1961 used more water from the first foot of soil depth than did alfalfa. All grasses used significantly less water at the fourth and fifth foot of soil depth than did alfalfa during both years.

Grasses contributed a larger proportion of the herbage dry matter yields when grown in association with birdsfoot trefoil than when grown with alfalfa. Orchardgrass in the second and third cuttings produced the most forage of the grasses grown in combination with a legume. In general, crude protein content increased when soil moisture became a limiting factor for the forages studied.

U. Nebr., Lincoln, Nebr.

182. Gomm, F. B. A COMPARISON OF TWO SWEETCLOVER STRAINS AND LADAK ALFALFA ALONE AND IN MIXTURES WITH CRESTED WHEATGRASS FOR RANGE AND DRYLAND SEEDING. J. Range Mangt. 17(1): 19-23. 1964.

At the Red Bluff Ranch near Norris, Mont., two strains of yellow sweetclover were compared with each other and with Ladak alfalfa for establishment and growth characteristics.

PI-L57, an unnamed large-seeded variety, emerged successfully from 2- to 3-inch depths with only slight reduction in number of seedlings established. Seedling numbers of Madrid seeded at depths greater than 1 inch declined rapidly. The seedling plants of PI-L57 were also larger and developed faster than those of Madrid during the first growing season.

In the second year, PI-L57 reached full bloom 2 weeks before Madrid, but was about 8 inches shorter. Except under extreme seeding treatments (broadcasting and drilling to 3-inch depth), Madrid produced considerably more herbage than PI-L57. Madrid also produced more than Ladak alfalfa.

Mixtures of the sweetclovers with Nordan crested wheatgrass produced more forage than either the grass or the legume alone. In the following year, grass in plots which had contained sweetclover in mixed stand continued to yield more than pure stands of grass.

The crude-protein content in herbage from the two sweetclover strains was equal to each other but higher than alfalfa. Protein content of grass grown in mixtures with legumes was generally higher than when grown in pure stand.

There was no significant effect on yield from mixing legume and grass seed before seeding or seeding legume and grass in alternate rows.

CRD, ARS, USDA, Bozeman, Mont.

183. Cooper, C. S., and Ferguson, H. INFLUENCE OF A BARLEY COMPANION CROP UPON ROOT DISTRIBUTION OF ALFALFA, BIRDSFOOT TREFOIL, AND ORCHARDGRASS. Agron. J. 56(1): 63-66. 1964.

Tana birdsfoot trefoil (Lotus corniculatus L.), Vernal alfalfa (Medicago sativa L.), and Potomac orchardgrass (Dactylis glomerata L.) were seeded alone and in one-grass-one-legume mixtures with and without a barley companion crop. At time of legume emergence, P-32 was injected beneath a row of grass or legume at depths of 3, 6, 12, 18, and 24 inches. Vertical and lateral growths of roots were determined periodically by P-32 assay of herbage samples from rows above and adjacent to the P-32 injection. Root distribution of the barley companion crop was also measured by P-32 assay. The influence of the companion crop on light interception, soil temperature, and soil moisture also was measured. In the year after seeding, P-32 was injected under rows of forage species at depths of 6, 12, 18, 24, and 30 inches. After injection, root distribution was measured periodically until mid-summer.

In the seeding year, roots of all species, when grown without barley, had penetrated to 24 inches or more by August 24. Rate of elongation of alfalfa was most rapid, followed by that of birdsfoot trefoil. When grown with a companion crop, alfalfa and orchardgrass roots had penetrated to a 16-inch depth and those of birdfoot trefoil to an 8-inch depth by August 24. Root elongation of the two legumes essentially ceased on July 6, when barley was fully headed. Growth of orchardgrass roots continued throughout the period of barley maturation. Vertical root measurements in the year after seeding indicated either considerable die-back of roots during winter or less absorption of P-32 in early spring. Depth of penetration did not appear to be greatly affected by previous establishment practice.

Lateral root growth in the seeding year was not detected at a lateral spacing of 6 inches when species were grown with barley. Without barley, lateral root growth was first measured at a 6-inch depth on July 6 for legumes and on July 24 for orchardgrass. At the last measurement in the seeding year, lateral root growths of the two legumes appeared to be similar and, except for growth at the 6-inch depth, were greater than growth of orchardgrass. In the year after seeding, lateral growth was greatest for alfalfa, followed by that of orchardgrass.

Barley roots had elongated 6 inches and spread laterally 5 inches before legume seedlings were 2 inches high. Two weeks later, barley roots had penetrated to a depth of 24 inches and spread 8 to 10 inches in the surface 12 inches of soil. Soil moisture content and soil temperatures were lower under the barley companion crop. Light interception by barley, when mature, varied from a high of 89 percent in early morning to 22 percent at 12 noon.

Forage seedling stands were not affected by the barley companion crop.

CRD, ARS, USDA, Mont. State Col., Bozeman, Mont.

184. Wolf, D. D., and Smith, D. YIELD AND PERSISTENCE OF SEVERAL LEGUME-GRASS MIXTURES AS AFFECTED BY CUTTING FREQUENCY AND NITROGEN FERTILIZATION. Agron. J. 56(2): 130-133. 1964.

Performance of nine forage mixtures (alfalfa, birdsfoot trefoil, and ladino clover in all combinations of a legume and a grass with bromegrass, orchardgrass, and timothy) was studied during 1960-61 at Arlington, Wis. Influence of two cutting frequencies (three and five times per season) and three levels of nitrogen (0, 200, and 400 pounds of N per acre) were measured in terms of hay yields and botanical composition. A residual harvest was made during the spring of 1962.

Hay yields for 2 years (1960-61) showed that mixtures containing alfalfa produced higher yields than mixtures containing ladino clover or birdsfoot trefoil. Yields of the latter two legume mixtures varied in rank with respect to each other. Mixtures containing orchardgrass outyielded those containing bromegrass or timothy. Timothy mixtures generally outyielded bromegrass mixtures. Alfalfa-orchardgrass produced the highest yields.

Hay yields for 2 years also indicated that mixtures under the three-cutting schedule produced higher yields than those under the five-cutting schedule. Yields from five cuttings were increased more by nitrogen applications than yields from three cuttings. Nitrogen had virtually no influence on yields of alfalfa mixtures cut three times.

Residual yields (1962) indicated that only alfalfa was left in its mixtures with bromegrass and timothy that were cut three times, but nearly equal proportions of each species were maintained in the alfalfa-orchardgrass mixtures cut three times.

A nearly balanced mixture of legume and grass was maintained in the alfalfa-bromegrass and alfalfa-timothy mixtures when cut five times, particularly where no nitrogen had been applied, and in the alfalfa-orchardgrass mixture cut three times. Birdsfoot trefoil and ladino clover mixtures were mostly grass, especially where nitrogen had been used.

Wis. Agr. Expt. Sta., Madison, Wis.

185. Schillinger, J. A., Jr., and Leffel, R. C. PERSISTANCE OF LADINO CLOVER (TRIFOLIUM REPENS L.). Agron. J. 56(1): 11-14. 1964

Experiments to determine the effects of environmental factors upon persistence of Ladino white clover were conducted from 1959-62. A management study included two levels of K fertilization, two levels of straw mulch, three levels of reseeding, and two species associations in a split-plot design. A persistence study included applications of foliar and soil fungicides and insecticides, alone and in combinations, as protective measure against pathological and/or entomological agents affecting persistence of Ladino clover. Frequency of application and pesticides employed varied with the season and with life cycles of suspected organisms. Both management and persistence studies were irrigated to maintain soil moisture for optimum growth throughout the growing seasons.

In the management study, persistence was not differentially affected by any of the variables employed. Plant stands of Ladino clover were reduced severely by the fall of 1961. Plant stands of Ladino clover were best maintained for the entire period by a preplanting methyl bromide soil funigation and subsequent applications of soil and foliar insecticides. This suggested that the nature of the lack of persistence of Ladino clover was an entomological-pathological complex.

Mich. State U., East Lansing, Mich.

186. Dwyer, D. D., Sims, P. O., and Pope, L. S. PREFERENCES OF STEERS FOR CERTAIN NATIVE AND INTRODUCED FORAGE PLANTS. J. Range Mangt. 17(2): 83-85. 1964.

Relative preference of yearling steers for 18 species of native and introduced forage plants was tested. Three-day grazing tests were made in May and August, 1963, using the same steers. Most of the species studied were planted in pure stands in plots 15 × 100 ft. Other species were not in plots but were abundant enough so that preferences of the steers could be tested. Percentage of plants grazed was considered index to preference for the species.

Johnsongrass was the most highly preferred species in both tests. Other species highly preferred were big and little bluestem, sand lovegrass, alfalfa, switchgrass, and King Ranch bluestem. Switchgrass rated high in the May test but rated zero in the August test. King Ranch bluestem was not rated in May due to winter-kill but rated high in the August test.

Weeping lovegrass, sericea lespedeza, sideoats grama, western ragweed, and western yarrow were ungrazed during both grazing tests.

Stage of maturity and color (as influenced by nitrogen content) were obvious factors which affected the selection of the steers for certain plants.

Okla. State U., Stillwater, Okla.

187. Hull, A. C., Jr. EMERGENCE OF CHEATGRASS AND THREE WHEATGRASSES FROM FOUR SEEDING DEPTHS. J. Range Mangt. 17(1): 32-35. 1964.

Cheatgrass and three wheatgrasses were seeded at depths of 0, ½, 1, and 2, inches in March 1961 and 1962. One-half inch was the best seeding depth for all species and 2 inches was the poorest. Cheatgrass had the highest and the most complete emergence from all seeding depths in each year. It was usually followed by siberian, crested, and fairway wheatgrasses in that order. Cheatgrass with its rapid emergence and vigorous growth was a strong competitor with seeded grasses. Competition with cheatgrass was not avoided by varying depth of seeding of wheatgrasses.

CRD, ARS, USDA, Logan, Utah.

188. Sexsmith, J. J. MORPHOLOGICAL AND HERBICIDE SUSCEPTIBLITY DIFFERENCES AMONG STRAINS OF HOARY CRESS. Weeds 12(1): 19-22. 1964.

Strains of hoary cress, particularly within the lens-podded species (Cardaria chalepensis (L.) Hand.-Maz.), varied greatly in leaf size and shape, spreading ability, stand density, and reaction to treatment with several herbicides. Without competition, heart-podded hoary cress (C. draba (L.) Desv.) spread farther and produced a denser stand than either lens-podded or globe-podded cress (C. pubescens (K. A. Meyer) Jarm.), and, in general, was more susceptible to 2,4-D and 2,3,6-TBA than lens-podded cress. Within 12 strains of lens-podded hoary cress, no relationship was found between susceptibility to 2,4-D or 2,3,6-TBA and any other characteristic.

Canada Agr. Res. Sta., Lethbridge, Alberta, Canada.

189. Miles, J. R. W., Sans, W. W., Wressell, H. B., and Manson, G. F. GROWTH-DILUTION AS A FACTOR IN THE DECLINE OF PESTICIDE RESIDUES ON ALFALFA-GRASS FORAGE. Canad. J. Plant Sci. 44(1): 37-41. 1964.

The persistence of endosulfan, Guthion, malathion, methoxychlor, Sevin, and toxaphene applied to alfalfa-grass forage for spittlebug control was studied by chemical analysis of deposits from application to harvest. Applications were made when the crop was 9 to 12 in. high. Malathion residues declined from 51 p.p.m. to trace amounts (0.26 p.p.m. or less) in 1 week, endosulfan from 18 to 0.36 p.p.m., and Sevin from 77 to 0.33 p.p.m. in 2 weeks, and Guthion from 74 to < 0.75 p.p.m. in 3 weeks. Methoxychlor and toxaphene treatments resulted in harvest residues from 1 to 9 p.p.m.

To assess the rate at which the residues would have declined if diluted by growth alone, forage was cut from unit areas and weighed at each residue sampling time. At harvest, the theoretical dilution by growth would have reduced the residues of methoxychlor and toxaphene to one-half their original level, whereas the actual residues were from one-fourteenth to one-eighth of the original deposits.

Ent. Lab., Canada Dept. Agr., Chatham, Ontario, Canada.

190. Fox, C. J. S. LONG-TERM EFFECTS OF INSECTICIDES ON WIREWORMS (AGRIOTES SPP.) OF GRASSLAND IN NOVA SCOTIA. Canad. J. Plant Sci. 44(1): 32-36. 1964.

Grassland experiments were conduced in four counties in Nova Scotia, Canada, from 1952-62 to evaluate the effectiveness of aldrin at 3 or 6 lb., dieldrin at 6 lb., chlordane at 8 or 10 lb., heptachlor at 6 lb., and lindane at 0.75, 1.0, or 1.5 lb. of toxicant per acre in controlling the wireworms Agriotes mancus (Say), A. sputator (L.), A. lineatus (L.) and A. obscurus (L.). The insecticides were applied once as surface sprays without subsequent cultivation, except in one experiment where oats were sown.

Aldrin, dieldrin, chlordane, and heptachlor usually did not control wireworms as well during the first year after application as during the second year. Aldrin and chlordane gave measurable control for as long as 10 years after application. Dieldrin and heptachlor gave at least 95 percent control 7 years (the duration of the pertinent experiments) after application. Lindane was not effective for as long as the other insecticides. In several cases, initial control was followed by a resurgence or "flare-up" of wireworm numbers. All treatments resulted in increased yields of hay, in some cases exceeding 200 percent, for several years after application.

Res. Sta., Canada Dept. Agr., Kentville, Nova Scotia, Canada.

191. Davis, D. E., Funderburk, H. H., Jr., and Roberts, D. R. THE BRISTLY THISTLE AND ITS CONTROL. Weeds 12(1): 22-25. 1964.

Bristly thistle (Circium horridulum Michx.) is an important perennial weed in Alabama pastures. It may remain vegetative many years before flowering and may regrow from the roots after flowering. A heavily infested pasture produced about 10,000 seedlings per acre per year of which 73 percent established from January through April. There was an average of 150 achenes per head but many did not contain fully developed seed. Essentially equal numbers of red and yellow flowered types were found. From two to as many as six successive cuttings below the soil surface were necessary to kill thistle plants. Thistle were effectively controlled by 2,4-D and MCPA.

Auburn U., Agr. Expt. Sta., Auburn, Ala.

192. Dobie, J. B., Curley, R. G., and Parsons, P. S. ECONOMICS OF HAY WAFERING: ANALYSIS OF OPERATING COSTS OF PRESENT SYSTEMS. Agr. Engin. 45(2): 74-77. 1964.

Wafering costs the hay producer more than baling, because of increased equipment cost and lower machine capacity, which more than offset the reduction in handling costs. At 3,000 tons per year, the producer's costs for wafering totaled $8.23 per ton with a $25,000 machine. Comparable baling costs were $4.99 per ton. Some premium is necessary for the producer to afford to sell wafers. The amount of premium required varies with the cost, capacity, and annual production of the wafering machine and associated equipment.

Consumers are now paying a premium of $5 per ton for wafered hay. The consumer's cost of handling, storing, and feeding wafers ranges from $1.17 to $1.84 per ton, compared with $2.41 for bales. Hauling costs $1 per ton less than baled hay. If wafers are self-fed, the dairymen must regain $2.76 per ton through increased production, reduced waste of hay, reduction of concentrates fed, improved employee relations, and convenience.

U. Calif., Davis, Calif.

Rangelands

SEE ALSO 56, 135, 162, 200, 202.

193. Schumacher, C. M. RANGE INTERSEEDING IN NEBRASKA. J. Range Mangt. 17(3): 132-137. 1964.

A range interseeder used for re-establishing climax dominant grasses on abandoned cropland, and other ranges in poor condition, was described and illustrated. The range interseeder is basically a lister equipped with double-disk furrow opener planting unit, packer wheel, and seed hoppers capable of handling fluffy seed as well as fine seed.

The interseeding method was best suited to sand or sandy sites though it showed promise on silty sites. Clay and clayey sites were more difficult to properly plant because of the problems of equipment operating and the hazards of soil crusting.

Range interseeding is an accepted range improvement practice in Nebraska, having been successfully used on 17,835 acres, principally on sand and sandy sites, since 1958.

Success of this method depends upon: Construction of a furrow that removes perennial and annual competition during the season of establishment; proper placement of the grass seed in the center of this furrow; selection of adapted ecotypes of climax dominant species that are of higher successional rank than the existing vegetation; and careful management of grazing to encourage the process of secondary plant succession after the seedlings have become established.

SCS, USDA, Lincoln, Nebr.

194. Bowns, J. E., Jr., and Box, T. W. THE INFLUENCE OF GRAZING ON THE ROOTS AND RHIZOMES OF SEACOAST BLUESTEM. J. Range Mangt. 17(1): 36-39. 1964.

Root systems of seacoast bluestem plants were examined in the Nueces fs of the Texas Coastal Prairie during the summer of 1961 in order to examine the effects of grazing under actual conditions.

Three groups of plants were used to represent intensities of grazing. Ungrazed plants were sampled from exclosures that had received no grazing for 4 years. "Wolf plants" or plants showing little evidence of grazing were selected as lightly grazed plants. Heavily grazed plants were those having no seed stalks or old dry foliage and ample evidence of heavy grazing.

The root systems of these plants were excavated by means of a core sampler. Measurements were taken on root production, basal areas, total top growth, current year's top growth, and rhizome production.

Root production was decreased by heavy grazing. Plants which were heavily grazed had significantly lower root production than either lightly grazed or ungrazed plants. No significant difference was found between the lightly grazed and ungrazed plants. The rhizome to root ratio was increased by heavy grazing.

Highly significant correlation existed between root production and basal area for the ungrazed and lightly grazed plants, but there was no significant correlation for the heavily grazed plants.

There were highly significant correlations between basal area and rhizome production for the heavily grazed and lightly grazed plants, but no significant correlation was found for the ungrazed plants.

Roots of heavily grazed plants reached a depth of 90 in. while the ungrazed plants reached a depth of 103 in.

Utah State U., Logan, Utah.

195. Pearson, L. C. EFFECT OF HARVEST DATE ON RECOVERY OF RANGE GRASSES AND SHRUBS. Agron. J. 56(1): 80-82. 1964.

Plots in rangeland were harvested by clipping at ground level. In general, woody species showed no recovery following such treatment.

Range grasses harvested during the period between boot stage and seed maturity did not recover as well as those harvested either earlier or later than this period.

Apparently food reserves in the roots were depleted during this critical period and the plants were highly susceptible to injury either by close clipping or by the grazing of livestock. It was suggested that many of our ranges could support larger populations of livestock with less damage to the forage if more attention was paid to the season of grazing.

Ricks Col., Rexburg, Idaho.

196. Johnson, W. M., and Reid, E. H. RANGE CONDITION CLASSIFICATION OF BUNCHGRASS RANGE AT THE MANITOU EXPERIMENTAL FOREST IN COLORADO. J. Range Mangt. 17(3): 137-141. 1964.

A method of determining range condition using factors measured by the loop method was evaluated on ponderose pine-bunchgrass range in Colorado. Range condition was classified by the relative production of desirable plants, desirability being based both on ecological status and forage values.

A good relationship was found between weight of herbage produced by desirable forage plants, and the percent cover of desirable plants and leaf height of mountain muhly. The regression equation for the vegetation and conditions of the study was $E = 8.77X_1+3.61X_2-134.63$, where E = estimated yield, X_1 = cover measurement of desirable species, and X_2 = maximum leaf height of mountain muhly expressed as a percentage of the leaf height of the muhly on a nearby ungrazed area. A chart, developed from the formula was presented for estimating range condition class of grassland openings in the ponderosa pine range at the Manitou Experimental Forest. The procedure was proposed as a method that will have a factual background and for which the reliability can be determined.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo.

197. Klemmedson, J. O., and Smith, J. G. CHEATGRASS (BROMUS TECTORUM L.) Bot. Rev. 30(2): 226-262. 1964.

Cheatgrass brome, also known as "downy chess", "downy brome", "broncograss", "Mormon oats", and "Junegrass", is an annual grass that has become widely established on western ranges since its introduction from Europe. It presents complex problems which for years have complicated the management of the ranges it inhabits.

In 1959, a cooperative research program on the management of cheatgrass ranges was started in southern Idaho. The literature about this important western range plant was reviewed. The Literature Cited section includes most of the important publications dealing with cheatgrass, its management, and ecology.

Intermountain Forest and Range Expt. Sta., FS, USDA, Boise, Idaho.

198. Jameson, D. A., and Johnsen, T. N., Jr. ECOLOGY AND CONTROL OF ALLIGATOR JUNIPER. Weeds 12(2): 140-142. 1964.

Alligator juniper (Juniperus deppeana Steud.) is a weed tree of Arizona and New Mexico. It sprouts from stems, roots, or especially from buds on the crown, wherever the top is destroyed. Adequate mechanical control requires that the root crown be removed from the soil. Treatment of stumps with pelleted fenuron on the soil or PBA sprayed on the stumps gave promising means of preventing sprouting.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Flagstaff, Ariz.

199. Murphy, A. H., and Crampton, B. QUALITY AND YIELD OF FORAGE AS AFFECTED BY CHEMICAL REMOVAL OF BLUE OAK (QUERCUS DOUGLASII). J. Range Mangt. 17(3): 142-144. 1964.

Treatment of blue oak by the cut-surface or basal frill method with 2,4-D resulted in some changes in species composition and considerable difference in yield. Forage yield was very sensitive to the tree treatment, with production exceeding that of open ground during the growing seasons following the chemical treatment.

Four annual grasses exhibited the greatest change in species composition under treee treatment with soft chess and wild oats increasing and ripgut and mouse barley descreasing. In the forbs, shade-loving species were eliminated, but others showed no consistent change due to tree treatment.

Hopland Field Sta., U. Calif., Hopland, Calif.

Plant Materials

SEE ALSO 107, 141, 148, 182, 207.

200. Gamble, M. D., and Rhoades, E. D. EFFECT OF SHORELINE FLUCTUATIONS ON GRASSES ASSOCIATED WITH UPSTREAM FLOOD PREVENTION AND WATERSHED PROTECTION. Agron. J. 56(1): 21-23. 1964.

Knowledge of inundation tolerance of range and pasture grasses in the Southern Great Plains permits the development of criteria for establishing and managing grasses in the temporary impoundment basins of floodwater-retarding structures.

Many factors, such as duration and depth of submergence, season, and frequency of flooding were associated with satisfactory survival of grasses when inundated. The grasses showed variable tolerance to inundation associated with shoreline fluctuations. Classification of inundation tolerance during the spring months for selected range and pasture grasses were:

1. Very strong tolerance (20 days and up)

    Bermudagrass (*Cynodon dactylon*)
    Buffalograss (*Buchloe dactyloides*)
    Vine mesquite (*Panicum obtusum*)
    Knotgrass (*Paspalum distichum*)

2. Strong tolerance (10 to 20 days)

    Western wheatgrass (*Agropyron smithii*)
    Reed canarygrass (*Phalaris arundinacea*)
    Kanlow switchgrass (*Panicum virgatum* var.)
    Switchgrass (*Panicum virgatum*)
    Caddo switchgrass (*Panicum virgatum* var.)
    Prairie cordgrass (*Spartina pectinata*)
    Beaked panicum (*Panicum anceps*)
    Florida paspalum (*Paspalum floridanum*)
    Tall fescue (*Festuca arundinacea*)
    Virginia wildrye (*Elymus virginicus*)

3. Moderate tolerance (5 to 10 days)

    Big bluestem (*Andropogon gerardi*)
    Woodward sand bluestem (*Andropogon hallii* var.)
    Kaw big bluestem (*Andropogon gerardi* var.)
    Indiangrass (*Sorghastrum nutans*)
    Johnsongrass (*Sorghum halepense*)

4. Mild tolerance (up to 5 days)

    Weeping lovegrass (*Eragrostis curvula*)
    KR bluestem (*Andropogon ischaenum* var.)
    Alkali sacaton (*Sporobolus airoides*)
    Elkan bluestem (*Andropogon ischaemum* var.)
    Little Bluestem (*Andropogon scoparius*)
    Silver bluestem (*Andropogon saccaroides*)
    Eastern gamagrass (*Tripsacum dactyloides*)
    Purpletop (*Tridens flavus*)

SCS, USDA, Oklahoma City, Okla.

201 Buglass, E. SEED PRODUCTION OF CRESTED WHEATGRASS AS INFLUENCED BY VARIOUS MANAGEMENT PRACTICES. Canad. J. Plant Sci. 44(1): 66-74. 1964.

The effect of nitrogen, phosphate, and spacing of grass rows on seed yields of crested wheatgrass was determined during the period 1954-62. Rates, time of application, and methods of applying fertilizer were studied along with the row spacing of the crested wheatgrass.

Fall application of nitrogenous fertilizers produced greater responses than early spring application. Moisture conditions were a limiting factor in obtaining seed increases from the use of fertilizer. Responses were greater with adequate moisture. In dry years, the response was very poor and a significant residual effect was obtained from nitrogen after dry years. Drilling the fertilizer into the sod was slightly superior to broadcasting. Fertilizer applied to the grass rows only, or to the grass rows and cultivated space, produced similar results. Grass seeded in wide-spaced rows produced higher yields of seed than did close drilling. Close-drilled rows of grass responded more to nitrogen than did wide-spaced rows. Grass seeded in 6-in. rows, and fertilized, produced less seed than wider-spaced rows with the same fertilizer treatment. With average moisture conditions, maximum yields of seed were obtained with about 150 lb./A. of ammonium nitrate. With better moisture conditions, seed yields increased as higher rates of fertilizer were used. Phosphate had no significant effect on seed yield.

Expt. Farm, Canada Dept. of Agr., Indian Head, Saskatchewan, Canada.

202. Wright, N. INFLUENCE OF MANAGEMENT PRACTICES ON SEED-SET, SEED YIELD, SEED WEIGHT, GERMINATION, AND INSECTS OF BLACK GRAMAGRASS (BOUTELOUA ERIOPODA (TORR.) TORR.). Agron. J. 56(1): 57-60. 1964.

Three experiments were conducted to study the influence of management practices on seed-set, seed yield, seed weight, germination, and insects of black gramagrass under irrigation. The variables included: (1) Preirrigation moisture levels; (2) irrigation schedules; (3) fertilizers; (4) insecticides; and (5) harvest dates.

Preirrigation levels did not influence any of the characteristics studied. Seed yield and germination percent were significantly higher for the August 1 irrigation schedule, than for August 15 in both years. Seed-set was highest (1 percent level of significance) at August 15 in 1958 while irrigation schedule did not influence seed-set in 1957. Seed weight was significantly increased at the August 1 irrigation schedule the first year. Irrigation schedules were nonsignificant the second year.

Fertilizers N, P, and K alone and in all combinations had no appreciable effect on seed-set, seed yield, seed weight, and germination percent (experiment A). In another trial (experiment C) N had an important effect on seed yield, which suggested that the use of N fertilizer would be beneficial at some locations or sites.

Seed-set and germination were not influenced by insecticides. Seed-yield was significantly increased by all insecticide treatments in 1959; however, there was no effect in 1958.

Significantly higher seed-set was obtained for the fall harvest compared to the summer harvest in 1959 and 1960. Nitrogen and the interaction (season X N) did not significantly influence seed-set. Seed yield was highest for the fall harvest with 100 pounds per acre of N.

Results of the studies suggested the desirability of combining treatments for highest seed production.

CRD, ARS, USDA, Tucson, Ariz.

SEE ALSO 13, 67, 98, 128, 132, 140, 177, 196, 199, 277.

203. Williams, R. D. RELEASE ACCELERATES HEIGHT GROWTH OF YELLOW-POPLAR SEEDLINGS. J. Forestry 62(2): 95-97. 1964.

Five-year results of a yellow-poplar (Liriodendron tulipifera L.) seedling release study in southern Indiana indicated that yellow-poplar seedlings grew much faster when free of overhead cover. On an area cut to 40 square feet of residual basal area per acre, three degrees of release were studied: (1) High release--trees larger than 6 inches d.b.h. were cut; (2) complete release--all woody vegetation over 5 feet tall was cut; and (3) no release.

Five years later the released trees were three times as tall as those not released. There were no clear-cut differences in survival or growth between trees on the high-release and complete-release plots. The small pole trees left on the high-release plots often became wolf trees and retarded the growth of the established yellow-poplar.

Yellow-poplar will not grow well under a canopy. While established seedlings can be released, the easiest and cheapest way to favor yellow-poplar on the new stand was to regulate the intensity of the harvest cut. The forester should mark to create openings within the effective seeding range of seed trees.

Central State Forest Expt. Sta., FS, USDA, Belfored, Ind.

204. Minckler, L. S., and Krajicek, J. E. PRUNING PIN OAK: RESULTS AND COSTS. J. Forestry 62(1): 19-22. 1964.

Trees 6 to 10 inches d.b.h. in well-stocked, pure, even-aged stands of pin oak (Quercus palustris Muenchh.) were pruned to 17 feet and 4 years later it was found that season of pruning (March, June, October) had no effect on number of new branches or on rate of healing. More than 90 percent of the pruning wounds were completely healed, and no rot was evident. On the average, 36 bole branches were pruned off and 4 years later there was an average of 7 new bole sprouts present; about 1/3 of them were already dead. The number of new bole branches had a positive relationship to the original number on the tree.

Trees exposed on the south-southwest side, as compared to unexposed trees, had more and much longer sprouts on the south-southwest side. Both exposed and unexposed trees had more new sprouts on the south-southwest side than on the opposite side. It was estimated that pruning may increase the probable future "Quality Index" 20 to 30 years hence from 59 to 90. Pruning time per tree ranged from 0.6 to 5.6 man-minutes for trees with 10 to 90 bole branches, respectively. Based on present dollar values, the probable net gain 30 years hence was estimated to be $3 for trees with 30 original bole branches but less for trees with fewer or more branches.

For the production of sawlogs, crop trees of pin oak should be pruned to at least 17 feet to produce a butt log with fewer defects than occur on unpruned trees.

Based on this study and related information, pruning should be done as follows:

1. Prune only well-formed, vigorous, dominant or codominant trees 5 to 8 inches d.b.h.
2. Saw off the branches on the butt 16-foot section flush with the bole. The low ridge of callus around the branches may be cut through but no special effort should be made to do this.
3. Avoid pruning tees that have many bole branches compared with the other trees in the stand.

4. Thin pole-sized stands 2 or 3 years before pruning to allow: (1) Development of the crown after thinning; (2) possible additional bole sprouting after thinning which can be pruned; and (3) a better judgment of final crop trees. About 60 crop trees per acre should be pruned. Where possible, pruned trees should not be exposed to prolonged direct sunlight on the boles.
5. Keep pruned trees in a free-growing condition by subsequent thinnings.

Northeastern Forest Expt. Sta., FS, USDA, New Lisbon, N.J.

205. Little, S., and Somes, H. A. RELEASING PITCH PINE SPROUTS FROM OLD STOOLS INEFFECTIVE. J. Forestry 62(1): 23-26. 1964.

In 1954, study treatments were started in Plains vegetation in southern New Jersey to: (1) Favor 400 selected pine sprouts per acre; or (2) to convert to a pine stand of seedling origin. Poisoning all competing sprout clums of pine and scrub oak doubled diameter growth of the selected sprouts, but did not increase height growth. After 6 years, these stems gave little promise of ever developing into merchantable trees. To grow trees of merchantable quality in Plains areas, the present sprout stands apparently must be converted to seedling stands.

The following ways of eliminating the present vegetation and preparing the sites for establishment of natural seedlings were given: (1) Mechanical clearing of strips with a bulldozer or other heavy equipment; and (2) use of chemical herbicides. Both methods should be supplemented with prescribed burning.

Northeastern Forest Expt. Sta., FS, USDA, New Lisbon, N.J.

206. Fedde, G. F. ELM SPANWORM, A PEST OF HARDWOOD FORESTS IN THE SOUTHERN APPALACHIANS. J. Forestry 62(2): 102-106. 1964.

The elm spanworm (Ennomos subsignarius [Hbn.]) epidemic in the southern Appalachians has continued for nearly a decade, and large portions of North Carolina Georgia, and Tennessee are still infested. Weather, parasitism, predation, and disease have exerted pressure in localized areas but have not prevented the spread of the spanworm into new localities.

Spanworm larvae in the southern Appalachians begin hatching from clusters of overwintering eggs toward the end of April. The intensity of larval feeding keeps pace with developing shoots until late June when pupation starts. Shortly thereafter, the moths emerge and the eggs are usually all deposited before the end of July.

Yearly larval defoliation of upland hardwoods during the early summer has resulted in tree mortality and stand deterioration. Hickories, white oak, and red oak have been most heavily attacked, although practically all hardwood trees, except yellow-poplar, are susceptible to some damage.

Besides timber losses, the spanworm has adversely affected forest recreation, hunting, fishing, and the summer tourist business.

Southeastern Forest Expt. Sta., FS, USDA, Asheville, N.C.

Windbreaks

SEE ALSO 131, 137.

207. Howard, G. S. SHELTERBELT TREE AND SHRUB SPECIES UNDER DRYLAND CULTURE IN THE CENTRAL GREAT PLAINS. U.S. Dept. Agr., Agr. Res. Serv. Prod. Res. Rpt. 78, 16 pp. 1964.

The response of certain shelterbelt tree and shrub species to dryland culture in the central Great Plains was given. This area covers approximately 150,000 square miles. Data were obtained on 482 representative shelterbelts from 1954-56; some of these were located in each of the 79 counties of the area.

The sample shelterbelts received many variations of acceptable cultural treatments, and a variety of different spacing distances were used.

Statistical results showed that greater differences in species response existed among altitude zones than among longitude or geographic zones. Therefore, the data were presented by altitude zones.

All tree and shrub species were rated according to their ability to provide shelter from the elements. Ratings were given without making allowance for differences in cultural treatments. Juniper, Ponderosa pine, honeylocust, Russian-olive, Siberian elm, American plum, common chokecherry, and Siberian peashrub had predominantly superior ratings.

Survival, height, spread, and killback data for 16 of the more promising or widely planted species were given by zones and age groups. Observational evidence indicated that more space per plant should be given for dryland shelterbelt plantings.

Species that survived and grew well were recommended for trial planting in the area.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md., 20781

208. Bagley, W. T. RESPONSE OF TOMATOES AND BEANS TO WINDBREAK SHELTER. J. Soil and Water Conserv. 19(2): 71-73. 1964.

In central Nebraska, changes in the microclimate induced by the sheltering effect of 7-foot-high slat-type windbreaks resulted in earlier germination, accelerated vegetative growth, earlier ripening of fruit of tomatoes, and 16 to 44 percent increases in the yields of tomatoes and snap beans.

U. Nebr., Lincoln, Nebr.

Fruit and Nut Crops

SEE ALSO 250.

209. Hilton, R. J., Bhar, D. S., and Teskey, B. J. E. THE EFFECT OF GRAFT-WOUND PROTECTANTS ON THE ESTABLISHMENT AND STRENGTH OF SCIONS ON FRAMEWORKED APPLE TREES. Canad. J. Plant Sci. 44(1): 42-46. 1964.

McIntosh apple scions were framework-grafted into scaffolds of four mature Northern Spy seedling trees. The union areas and scion tips were protected with one of: Two grafting waxes; an asphalt emulsion; or three adhesive tapes such as are used for electrical work or general mending.

After one season's growth, records of scion "take" and vigor, and of the strength-at-union, were analysed to determine influences of the various desiccation barriers. In general, the materials were effective for their intended use, but the asphalt emulsion and an impregnated fabric-base friction tape were associated with scion "take" and vigor that were relatively poor. Of these two materials, the tape was associated with a significant reduction in the force required to break the scions away from the stock branches.

It was evident that modern plastic tapes may be used effectively to prevent tissue desiccation in framework-grafting deciduous trees.

Ontario Agr. Col., Guelph, Ontario, Canada.

210. Markwardt, E. D., Guest, R. W., Cain, J. C., and LaBelle, R. L. MECHANICAL CHERRY HARVESTING. Trans. ASAE 7(1): 70-74, 82. 1964.

Growers confronted with rising wage rates, a dwindling labor supply, and increasing problems in managing this labor, are searching for alternatives to hand labor. Mechanical cherry harvesting methods were studied as one alternative.

Cherry trees were given varying degrees of pruning to determine the effect on yield and the efficiency to harvest. Trees receiving the most severe pruning produced 67 percent as many cherries the first year after pruning and 92 percent as many the second year. The time to harvest was less than half as long on maximum-pruned trees as for the conventionally pruned trees. The moderate pruning done in 1961 resulted in only a 12 percent loss in production the first year but a 65 percent savings in time to harvest. The minimum pruning caused no loss in production and about a 50 percent saving in time.

Nitrogen fertilizer tended to delay maturity. Trees with 0.5 percent more nitrogen in the leaves averaged about 8 percent less fruit harvested on four harvest dates. There was also a higher proportion of attached stems. Trees higher in nitrogen should be harvested at a later date than those at a lower level of fertility.

Early in the season, the fruit was held to the stem with greater force than the stem to the tree. When the fruit were mature, the fruit retention force was only one-third as much as the stem retention force. The proportion of attached stems was minimized by proper attention to maturity.

The residual fruit left on the tree after shaking was less mature than that shaken off. A reharvest at a later date would have been impractical as an average of 46 percent of the fruit showed damage after 3 days.

Mechanically harvested cherries were equal in both product yield and quality of processed product to those picked by hand. Under the conditions of the 1961 harvest, there was some loss of yield and perhaps quality. However, properly designed and operated equipment provided adequate protection of fruit quality during harvest.

Increased pruning tended to reduce the amount of bark damage from the shaker.

Different combinations of stroke length and frequency of shake were tried. Ninety-five percent of the fruit was removed from the tree when the total travel of the claw exceeded 1800 in. per minute. The 1-in. stroke tended to cause less bark damage.

With proper attention to machine design and orchard management, mechanical harvesting of red tart cherries was not only practical but economical. Product quality was maintained with proper consideration to equipment and to handling procedures.

Cornell U., Ithaca, N.Y.

211. Jutras, P. J., and Coppock, G. E. HARVESTING CITRUS FRUIT WITH AN OSCILLATING AIR BLAST. Trans. ASAE 6(3): 192-194. 1963.

An oscillating air blast machine was constructed to study the possibility of using this principle for harvesting citrus fruit mechanically. Tests performed in mature groves of different varieties indicated that air velocities ranging between

8,600 and 10,000 f.p.m. at the source were necessary to obtain fruit removal of 40 to 95.6 percent at a rate of travel of $\frac{1}{4}$ m.p.h. The higher efficiencies (90 to 95.6 percent) were obtained at oscillation rates of 50 to 80 per minute, a relatively high W/F ration, and air velocities in the 9,500 to 10,000 f.p.m. range.

In Valencias, the higher efficiencies were obtained with air velocities of 8,600 f.p.m. and double exposure with a period of 10 days between treatments.

Leaf damage was more prevalent in oranges than in grapefruit, but seemed to be reduced by the application of a polyvinyl solution on the leaves prior to harvesting.

U. Fla., Citrus Expt. Sta., Lake Alfred, Fla.

212. Raine, J. EFFECT OF RASPBERRY CROWN BORER (BEMBECIA MARGINATA) ON YIELD OF LOGANBERRIES. Canad. J. Plant Sci. 44(1): 75-77. 1964.

During a 4-year period, loganberry plants artifically infested with eggs of the raspberry crown borer produced significantly less fruit than a similar number of plants kept free of borers by drenching with diazinon. The average annual loss per acre was 461 lbs. of fruit worth $70.

Res. Sta., Canada Dept. Agr., Vancouver, British Columbia, Canada.

213. Morgan, G. T. EFFECTS OF SPRING PREPLANTING FUMIGATION IN STRAWBERRY SOIL IN NEW BRUNSWICK. Canad. J. Plant Sci. 44(2): 170-174. 1964.

D-D proved more effective than Dowfune W-85, Nemagon, or Vapam as a soil fumigant in preplanted spring treatment for control of Pratylenchus penetrans for reduction of strawberry root rot, and for increasing the yield of strawberries. D-D also provided the largest yield increases when the same materials were compared in summer and fall treatments.

Res. Sta., Canada Dept. Agr. Frederiction, New Brunswick, Canada.

Field Crops

SEE ALSO 35, 40, 45, 58, 59, 60, 65, 66, 68, 72, 86, 87, 110, 111, 112, 113, 114, 115, 116, 117, 130, 131, 133, 136, 137, 143, 144, 151, 153, 154, 158, 159, 161, 166, 171, 173, 174, 178, 183, 235, 251, 302, 304, 306, 317.

214. Foth, H. D., Robertson, L. S., and Brown H. M. EFFECT OF ROW SPACING DISTANCE ON OAT PERFORMANCE. Agron. J. 56(1): 70-73. 1964.

A 3-year study was made to evaluate the effect of row spacing distance on oats performance. Oats grown in the most closely spaced rows consistently had more panicles (or culms) per unit area and a higher yield of grain and straw than the wider spaced rows. Of the yield components, seed weight was the least affected by row spacing distance and had the least effect on yield.

Response of the plants to row spacing distance was markedly affected by weather. There appeared to be little, if any, relationship between the percentage of N, P, and K in plant tissue and distance between rows. Total accumulation in pounds per acre of the three nutrients in plant tissue was closely related to total growth.

Oats grown in the narrowly spaced rows had the greater weight of roots per acre. This difference was due primarily to differences in the upper 3 inches of soil between the regions immediately below the rows and those regions 2 or more inches away from the row. Root density and distribution appeared unrelated to the row spacing distances below a depth of 6 inches.

It was concluded that the greater nutrient accumulation and total growth in pounds per acre on plots with the most closely spaced rows were more likely the result of better utilization of light in photosynthesis than any difference associated with the root system.

Mich. Agr. Expt. Sta., East Lansing, Mich.

215. Bond, J. J., Army, T. J., and Lehman, O. R. ROW SPACING, PLANT POPULATIONS AND MOISTURE SUPPLY AS FACTORS IN DRYLAND GRAIN SORGHUM PRODUCTION. Agron. J. 56(1): 3-6. 1964.

Dryland grain sorghum row spacing and plant population studies with different amounts of soil moisture at seeding were conducted on Pullman cl at Bushland, Tex., in 1958-59. Grain yields were markedly increased with increasing amounts of soil moisture at seeding. Except at the high moisture level, grain yields were lower with the 4-pound seeding rate than with the 2-pound seeding rate. Generally, more grain was produced at the lower moisture levels with 40-inch rows than with 20-inch. However, 20-inch rows produced greater yields at the highest moisture levels.

Stover yields were increased by greater amounts of soil moisture at seeding. Generally, the 4-pound seeding rate and 20-inch rows produced more stover than the 2-pound seeding rate or 40-inch rows. At the lower moisture levels, high seeding rate and narrow row spacings tended to increase stover yields as well as decrease grain yields; hence, greater stover-grain ratios.

Lodging was influenced by soil moisture, seeding rate, and row spacing. Increased soil moisture at seeding tended to decrease lodging. Generally, lodging was greater with the 4-pound seeding rate than with the 2-pound. Plants in 40-inch rows lodged more than those in 20-inch.

Total seasonal water use was not measureably affected by cultural treatments. The high seeding rate and narrow row spacing resulted in increased water use early in the growing season. This resulted in a moisture deficiency at heading, severe drought damage, and reduced grain yields. Water use efficiencies for both grain and stover production were increased with greater amounts of soil moisture at seeding.

When considered simultaneously with long-term weather records, a population of 18,000 plants per acre in 40-inch rows can be expected to result in the best grain yields most of the time.

On the hardlands of the southern High Plains practices such as high seeding rates and narrow rows which increase residue production and consequently reduce the erosion hazard will generally decrease grain yields.

SWCRD, ARS, USDA, Mandan, N. Dak., 58554

216. Stickler, F. C. STAND ESTABLISHMENT AND YIELD OF GRAIN SORGHUM AS AFFECTED BY METHOD OF PLANTING AND USE OF PRESS WHEELS. Agron. J. 56(1): 53-56. 1964.

Different methods of planting grain sorghum at three seeding rates were evaluated under varying conditions in Kansas by using different machines and press wheel equipment. In 14 of 15 trials, highest yields were obtained with the high seeding rate (2.5-inch seed spacing). Yields of different stand levels were remarkably similar though seeding rates varied by 400 percent, indicating great capacity of grain sorghum to adjust for stand differences through head size and tillering.

Stand establishment percentages varied among individual experiments and were influenced by soil moisture relationships during and after planting.

Where surface soil moisture availability was low, the small lister opener resulted in best stand establishment. Press wheels were especially beneficial with this machine. Under favorable planting conditions, the unit-type planter (equipped with double disk opener) gave highest stand establishment and yields.

Regular press wheels resulted in better stand establishment. The seed-firming type of press wheel was found especially valuable in increasing stand establishment of grain sorghum. In 1961 and 1962, where direct comparisons were made, press wheels increased stands 14 percent and yields 8 percent.

Agr. Expt. Sta., Kansas State U., Manhattan, Kans.

217. Duke, G. B., and Alexander, M. EFFECTS OF CLOSE-ROW SPACINGS ON PEANUT YIELD AND ON PRODUCTION EQUIPMENT REQUIREMENTS. U.S. Dept. Agr., Agr. Res. Serv. Prod. Res. Rpt. 77, 14 pp. 1964.

Experiments conducted in 1957-59 with peanuts flat planted with conventional and close-row spacings and treated with a herbicide showed that, with bunch-type peanuts, hoeing labor requirements for weed control were about equal regardless of row spacing. The runner type peanuts planted in closely spaced rows required more hoeing labor than those planted in conventionally spaced rows.

In 2 of the years, both bunch- and runner-type peanuts planted in close rows outyielded those planted in conventional rows by 349 and 124 pounds per acre, respectively. The 3-year average yield of the bunch-type planted in close rows showed an increase of 146 pounds per acre over those planted with conventional spacings, whereas the runner-type planted in close rows showed no increase in yields. The 3-year results were not significant due to any of the spacing treatments with either type.

The bunch-type peanuts planted in conventionally spaced rows produced more extra large kernel peanuts than did those planted in close rows.

Closely spaced peanut rows were effectively planted and cultivated with conventional farm equipment. A peanut digger equipped with a power-operated conveyor and soil separators was developed for digging, shaking, and windrowing conventionally spaced peanut rows. By mounting longer digger blades, the same equipment was used for digging either three or four closely spaced peanut rows.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md., 20781

218. Colville, W. L., and Burnside, O. C. INFLUENCE OF PLANTING METHOD AND ROW SPACING ON WEED CONTROL AND CORN YIELDS. Trans. ASAE 6(3): 223-225. 1963.

Plant population, method of planting, row spacing, and method of weed control were important factors in determining yields of irrigated corn in experiments conducted in Nebraska during 1956-62. Drilled corn produced 14 percent more grain than checked corn. The highest yielding population, 23,520 plants per acre, produced yields 12 percent greater than a population of 11,760 plants. Maxiumum grain yields of checked corn were obtained at some 4,000 plants less than in drilled plots. The importance of plant population and of distributing plants uniformly and singly within the row was evident as 23,520 plants drilled produced 34 percent more grain (shelled corn) than 11,760 plants checked.

Equidistant spacing and weed-control practices were fundamental in determining corn yields and weed growth. Single hand-weeded plants, spaced equidistantly 20 in. apart produced 39 percent more corn than the same per acre population (15,680) planted in equidistantly spaced (40-in.) hills with four plants per hill. The average grain yields from 20-in. spacings were nearly twice that of similarly treated 40-in. spacings that had received atrazine.

Weed yields were reduced in narrow-row spacings due to earlier shading of ground surfaces. The effect of population on reduction of weeds in 30-in. rows was evident. Row-spacing, when 20 and 40-in. spacings were compared, had little influence on weed yields in plots that recieved 2,4-D. Corn yields showed that some type of chemical or mechanical weed control was needed until the time the soil was completely shaded by corn. In 1962, atrazine accomplished this objective fairly well as evidenced by corn yields from 20-in. spacings that were equal to those of hand-weeded plots. However, fall panicum a slightly later starting grassy weed was not controlled by atrazine. In 40-in. spacings where light was plentiful, fall panicum made excellent growth and it markedly reduced corn yields.

The yield components responsible for grain yield differences in both experiments were barren plants and ear size. Ear size and the number of barren plants was increased by any means that crowded plants together.

Lodging, broken stalks, and dropped ears were not a problem in either experiment. Picker-shellers and corn combines in association with drying equipment that permit earlier harvest are lessening the importance of these factors in the production of corn.

U. Nebr., Lincoln, Nebr.

219. Sand, P. F., Robinson, E. L., and Dowler, C. C. THE EFFECT OF SEVERAL HERBICIDES ON THE CONTROL OF WITCHWEED IN CORN. Weeds 12(1): 37-39. 1964.

The alkanolamine salt of 2,4-D, the dimethylamine salt of 2,3,6-TBA, and the sodium salt of fenac, were evaluated in controlling witchweed and toxicity to corn on germinating seed in petri dishes, as preplanting, preemergence, and postemergence treatments in the greenhouse; as preplanting, soil-incorporated treatments in the greenhouse; and as preplanting, soil-incorporated treatments in the field. Corn roots were affected more than the shoots by each herbicide. Fenac and 2,4-D inhibited root growth of corn seedlings in petri dishes more than 2,3,6-TBA. Fenac was the most effective herbicide for control of witchweed and weedy grasses when applied as a preplanting, soil-incorporated treatment and controlled witchweed at rates which significantly increased corn yields. Applied preplanting, 2,4-D did not control witchweed and 2,3,6-TBA at rates which gave witchweed control equivalent to that obtained with fenac was toxic to corn.

CRD, ARS, USDA, Whiteville, N.C.

220. Robinson, R. G., Nelson, W. W., Thompson, R. L., and Thompson, J. R. HERBICIDES AND MIXTURES FOR ANNUAL WEED CONTROL IN GRAIN SORGHUM. Weeds 12(2): 77-79. 1964.

Mixtures of CDAA + atrazine or propazine applied preemergence gave excellent grass and non-grass weed control and no sorghum injury. Such mixtures offer promise of more consistent weed control than either component alone and less soil residue than a higher rate of atrazine or propazine alone. CDAA + trichlorobenzyl chloride preemergence was a less effective mixture but gave better grass weed control and poorer non-grass control than propazine or atrazine pre- or postemergence. Atrazine or propazine postemergence following CDAA preemergence gave excellent results.

The best time to spray sorghum with atrazine or propazine between planting and the 11-leaf stage was when the weeds were in the very early postemergence stage. Sorghum was tolerant at all times of application. Atrazine over all trials averaged superior to propazine as an herbicide for grain sorghum.

U. Minn., St. Paul, Minn.

221. Phillips, W. M. A NEW TECHNIQUE OF CONTROLLING WEEDS IN SORGHUM IN A WHEAT-SORGHUM-FALLOW ROTATION IN THE GREAT PLAINS. Weeds 12(1): 42-44. 1964.

Atrazine applied a 3 lb./A. to wheat stubble shortly after harvest in 1961 and 1962 controlled all vegetation for the remainder of the season. Propazine was nearly as effective as atrazine in 1962. Grain sorghum was planted in the spring of 1962. No preplanting tillage was used, and no weed control measures were needed in sorghum during the growing season on the treated plots, and crop stands, vigor, and grain yields were superior to those on the cultivated checks.

CRD, ARS, USDA, Agr. Expt. Sta., Hays, Kans.

222. Molberg, E. S. DAMAGE TO FLAX BY 2,4-D AND MCPA APPLIED IN DIFFERENT VOLUMES OF WATER. Canad. J. Plant Sci. 44(1): 85-88. 1964.

Injury to flax caused by 2,4-D and MCPA was decreased by increasing the volume of water applied with the herbicides. The crop recovered from initial injury and average yields were not reduced by any of the treatments. The only deleterious effect of the herbicides was a delay in maturity which increased the risk of damage from frost and unfavorable harvest weather. As the spray volume was decreased from 15 to 2.5 gal./A. (active) delays in maturity were increased. Except in 1959, it was possible to apply an amine of 2,4-D or an ester of MCPA at 8 oz./A. without delaying maturity by using 15 gallons of spray per acre.

Expt. Farm, Canada Dept. Agr., Regina, Saskatchewan, Canada.

Vegetable Crops

SEE ALSO 39, 60, 72, 103, 143, 151, 163, 167, 208, 301, 302, 304.

223. Finney, E. E., Hall, C. W., and Thompson, N. R. INFLUENCE OF VARIETY AND TIME UPON THE RESISTANCE OF POTATOES TO MECHANICAL DAMAGE. Amer. Potato J. 41(6): 178-186. 1964.

Significant differences existed between certain potato varieties in their response to applied stress or surface pressure. From the standpoint of the stress required to rupture the tuber skin and the tissue immediately beneath the skin, Kennebec was significantly lower in resistance to injury than Russet Burbank, Katahdin, Sebago, and Onaway.

The resistance of the potatoes to injury decreased with time during the pre-harvest tests, and increased with time after harvest. It was suggested that soil moisture may interact with time to cause a decrease in the resistance of the potato to mechanical pressure during the pre-harvest season.

After a 1 month curing period, the energy the tubers could withstand increased by 30 to 80 percent.

No linerar correlation was found between specific gravity and the mechanical loads necessary to rupture the potato tuber.

Mich. State U., East Lansing, Mich.

224. Way, J. M. THE EFFECTS OF SUB-LETHAL DOSES OF MCPA ON THE MORPHOLOGY AND YIELD OF VEGETABLE CROPS: III. CARROTS AND PARSNIPS. Weed Res. 3(2): 98-108. 1963.

The effect of sub-lethal doses of MCPA-sodium on the morphology, growth, and yield of carrots and parsnips was studied in 20 replicated field experiments. Slight epinasty was produced in carrots by doses as low as 0.002 lb./A. (active), but formative effects were not usually seen below 0.01 lb./A. Crop weight was only reduced by doses greater than 0.1 lb./A., but abnormalities rendered a proportion of the roots unmarketable at doses below 0.05 lb./A. Small plants were sometimes killed by 0.3 lb./A. but larger plants survived treatment with up to 0.5 lb./A. Tests on carrots which were unmarketable on grounds of appearance failed to reveal any effect of MCPA on flavor, sweetness, or texture of the roots. The effects of MCPA on parsnips were similar to those on carrots, but the expression of injury symptoms was generally less marked.

Natl. Veg. Res. Sta., Wellesbourne, Warwick, England.

225. Hunter, J. E., and Rich, A. E. THE EFFECT OF POTATO SPINDLE TUBER VIRUS ON GROWTH AND YIELD OF SACO POTATOES. Amer. Potato J. 41(4): 113-116. 1964.

The presence of spindle tuber virus in Saco potatoes caused slow development of sprouts and slow emergence of plants. Infected plants were stunted and spindly with a sharp angle of branching, and the leaves developed tip burn. Infected plants died prematurely and the number and size of tubers were smaller than expected. Infected hills yielded only 35.2 percent as much as healthy hills. Yield reduction was due partly to fewer tubers per hill but mostly to their smaller size. This factor, plus the spindle shape, would place many of them in an inferior grade.

U. N.H., N.H. Agr. Expt. Sta., Durham, N.H.

226. Fox, C. J. S., Chisholm, D., and Stewart, D. K. R. EFFECT OF CONSECUTIVE TREATMENTS OF ALDRIN AND HEPTACHLOR ON RESIDUES IN RUTABAGAS AND CARROTS AND ON CERTAIN SOIL ARTHROPODS AND YIELD. Canad. J. Plant Sci. 44(2): 149-156. 1964.

Aldrin or heptachlor at 5 and 10 lb. per acre were each incorporated into a sandy loam for 3 successive years. On a total weight basis, rutabagas grown on treated soil were found at harvest to contain up to 0.02 p.p.m. of aldrin, 0.06 p.p.m. of dieldrin, 0.01 p.p.m. of heptachlor, and 0.03 p.p.m. of heptachlor epoxide; and carrots up to 0.15 p.p.m. of aldrin, 0.15 p.p.m. of dieldrin, 0.26 p.p.m. of heptachlor and 0.04 p.p.m. of heptachlor epoxide. Significant off-flavors were noted in raw carrots after 3 years of soil treatment with the higher rate of heptachlor but not a year later when the insecticide was not applied.

Treated plots produced significantly higher yields of beans and carrots than untreated check plots only in the first year of treatment. The increases were attributed to the control of injurious soil insects. Both insecticides gave significant control of cabbage maggot throughout the experiment. Soil mites were reduced in number after the first year of treatment but numbers of Collenbola in the soil were not significantly affected.

Res. Sta., Canada Dept. Agr., Kentville, Nova Scotia, Canada.

Costs and Returns

SEE ALSO 36, 55, 56, 192, 204, 210.

Soil Conserv. 29(11): 243-264. 1964.

The June issue of Soil Conservation was devoted to articles on soil conservation practices. The following list gives the author, title, and address of authors of each article.

227. Francis, C. J., and Archer, S. G. EARTHMOVING IS BIG PART OF SOIL AND WATER CONSERVATION. SCS, USDA, Washington, D. C., 20005.

228. Riek, H. W. RUBBER TUBE SOLVES SEEPAGE PROBLEM IN IRRIGATION DITCH. SCS, USDA, Billings, Mont.

229. Decker, R. S. SOIL MECHANICS TESTS GUIDE DESIGN OF EARTH STRUCTURES IN CONSERVATION. SCS, USDA, Lincoln, Nebr.

230. Little, W. C. COST OF PARALLEL TERRACES DEPENDS LARGELY ON AMOUNT OF EARTHMOVING. SWCRD, ARS, USDA, Watkinsville, Ga., 30677

231. Anderson, D. J. WATERSHED PROJECT PROTECTS MONTANA CITY AGAINST FLOODS. SCS, USDA, Plentywood, Mont.

232. McClure, W. T., Jr. AN AWARD-WINNING PICTURE STORY: BUILDING A FLOODWATER-RETARDING DAM. SCS, USDA, Walhalla, S.C.

233. Allen, W. S. FLOOD PREVENTION STORY GETS SOUTHEAST HEADLINES. SCS, USDA, Spartanburg, S.C.

234. Ogrosky, H. O. WAS THE OHIO FLOOD NECESSARY? SCS, USDA, Washington, D.C., 20005

235. Stewart, K. V., Jr. WATER LEVELING LOUISIANA RICELAND SAVES LABOR AND IRRIGATION WATER. SCS, USDA, Alexandria, La.

236. Colvin, J., Jr. BASIN IRRIGATION SYSTEM STOPS HIGH PUMPING COSTS. SCS, USDA, Yuma, Ariz.

237. Long, H. H. "WATERSHED PHILOSOPHY" SPREADS ALONG HADLEY CREEK AND BEYOND. SCS, USDA, Macomb, Ill.

238. Landers, R. H. LAND GRADING RAISES YIELDS AND BENEFITS RURAL ECONOMY. SCS, USDA, Cape Girardeau, Mo.

239. Cross, J. M. ELEMENTARY TEACHING STUDENTS TIE CONSERVATION TO SUBJECTS. SCS, USDA, Alexandria, La.

Soil Conserv. 29(6): 123-143. 1964.

The January issue of Soil Conservation was devoted to articles on conservation planning. The following list presents the author, title, and address of author for each article.

240. Silkett, V. W. TODAY'S CONSERVATION PLANNING IS SHAPED TO BROADENED NEEDS. SCS, USDA, Washington, D.C., 20005

241. Healey, L. R. CONSERVATION--NOT MORE LAND--FILLS COLORADAN'S INCOME NEEDS. SCS, USDA, Colbran, Colo.

242. Gibson, G., and Patton, C. R. CONSERVATION PLANNING BRINGS COMMUNITY CASH--BETTER LIVING. SCS, USDA, Sneedville, Tenn.

243. Roth, B. A. COLONIAL TOWN USES SOIL SURVEY IN PLANNING FOR TODAY'S GROWTH. SCS, USDA, Upper Darby, Pa.

244. Bellard, C. "HI NEIGHBOR!" COMPANY'S KEY TO CONSERVATION RECREATION--JOBS. SCS, USDA, Alexandria, La.

245. Freeman, O. L., and Baker, J. A. EXCERPTS FROM "A PLACE TO LIVE," THE YEARBOOK OF AGRICULTURE. USDA, Washington, D.C., 20005

246. Dailey, R. M. COMMUNITY WATERSHED DAM HELPS CUT FIRE INSURANCE. SCS, USDA, Washington, D. C., 20005

247. Anonymous. FIRST CONSERVATION DISTRICT FARM PLAN MARKER.

248. Tidwell, H. CROPLAND CONVERSION IS BOON TO THESE HUNTERS AND FISHERMEN. SCS, USDA, Rayville, La.

249. Shipp, R. KLUBERT WARENBOUGH. No address given.

250. Kidd, G. J. ORCHARDIST BROTHERS COMBINE CONSERVATION--MARKETING TRICKS. SCS, USDA, Madison, Va.

251. Stevens, W. W. NORTH CAROLINA TOBACCO GROWERS LIKE TALL FESCUE IN ROTATIONS. SCS, USDA, Raleigh, N.C.

252. Kirby, R. R., and Gilliam, J. W. DISTRICT COOPERATOR'S HOME MOVIE SHOWS NEIGHBORS HOW TO BUILD POND. SCS, USDA, Henderson, Tenn.

253. Mace, B. RIGHT EQUIPMENT HELPS DISTRICT DO EFFICIENT CONSERVATION JOB. President, Amador County Soil Consv. Dist., Jackson, Calif.

254. Mathey, N. A. THESE IRRIGATION FARMERS RESTORE ALKALI LANDS. SCS, USDA, Coolidge, Ariz.

255. Fuqua, J. E., and Walkup, H. G. BULK FERTILIZER SPREADING PRACTICES IN KENTUCKY--WITH SPECIAL EMPHASIS ON THREE-HOPPER TRUCK SPREADER CUSTOM SERVICES. Ky. Agr. Expt. Sta. B. 683, 42 pp. 1963.

A new fertilizer marketing method in Kentucky was studied in a 12-country area. The study was made to: (1) Determine dealers' costs of owing and operating a three-hopper truck fertilizer spreader as a custom service; and (2) determine farmers' costs of fertilizing their fields with that custom service as compared with their costs when using other methods of applying fertilizer.

Custom service of a three-hopper truck spreader provides a convenient method of fertilizer application of straight fertilizer materials, reduces the need for farm labor, machinery, and capital investment, and usually results in a lower cost for fertilizer applied than when farmers use their own equipment.

From the dealers' standpoint, the cost of owning and operating a three-hopper truck fertilizer spreader decreases as more acres are fertilized annually. The following acreages and corresponding costs per acre of owning and operating the truck spreaders--excluding fertilizer costs--show the general relationship of larger acreages to lower costs: 500 acres, $4.08 per acre; 1,000 acres, $2.30; 2,000 acres, $1.40; 3,000 acres, $1.11; and 4,000 acres, $0.96. If a dealer charges $1.50 per acre custom rate, about 1,800 acres of fertilizer custom spreading would be needed for him to break even. About 1,385 acres of custom spreading would be required to break even if the custom charge was $1.80 per acre.

Rates for use of three-hopper truck spreader custom service varied among dealers, the most usual rate being $1.50 per acre. Some charged $2 for spreading on plowed land and $5 for tobacco land. Seven of the 12 dealers required a minimum custom charge per job of $5 to $12.50.

In 1960, the primary nutrients in the following fertilizers could be bought for less per ton in straight materials than in mixed fertilizers by the indicated amounts: 10-10-10, $7.35 to $12.60; 5-10-15 (tobacco fertilizer including potassium sulfate), $7.20 to $10.87; 4-12-8, $8.32 to $12.14; 5-20-20, $4.47 to $10.29; and 0-20-20, $9.22 to $13.45.

A comparison of equivalent amounts of primary plant nutrients from straight materials applied with the three-hopper truck spreader custom service versus a pull-type, single-hopper spreader owned by the farmer and using mixed fertilizer showed the truck spreader custom service to be less costly for all crops and acreages considered. Other methods of application studied were: Mixed fertilizers handled in bulk and spread with a single-hopper truck spreader; straight fertilizer materials bulk blended and spread with a single-hopper truck spreader; and mixed liquid fertilizers applied with conventional bulk liquid application equipment. In general, the cost per acre of fertilizer applied by these methods was less than when farmers used mixed fertilizers in bags applied with a pull-type single-hopper spreader, but more than the cost per acre of fertilizer applied with the three-hopper truck spreader using straight materials.

If the average-size farm of 132 acres in the 12-county area was fertilized at recommended rates, the 94.1 acres of crops could be fertilized with a three-hopper truck spreader and straight materials for $167.25 less per year than with a pull-type single-hopper spreader and mixed fertilizers.

Lower cost of applying fertilizer was the advantage most frequently mentioned by farmers who had used the three-hopper truck spreaders. "Saves labor" and "saves time" were the next two advantages reported.

U. Ky., Agr. Expt. Sta., Lexington, Ky.

256. Sundquist, W. B., Day, L. M., and Jensen, H. R. INCOME-IMPROVING FARM ADJUSTMENTS IN SOUTHEASTERN MINNESOTA: CONSIDERING CHANGES IN FARM RESOURCES AND IN MILK AND HOG PRICES. Minn. Agr. Expt. Sta., Sta. B. 466, 28 pp. 1964.

The reorganization of farms in the traditional "dairy area" of Southeastern Minnesota was studied. Income possibilities were determined by adjusting current farm organizations. Livestock enterprises considered as possibilities were: (1) Stanchion dairy with milk production for manufacturing uses; (2) conversion to a labor-efficient loose housing-milking parlor dairy setup on farms where adequate capital was available; (3) production and feeding out of hogs, including the possibility of purchasing and feeding out 35-pound feeder pigs; (4) production of beef calves from a cow-calf enterprise; and (5) purchase and feeding out of yearling feeder steers or calves. Three different crop rotations and two levels of soil fertility and crop management were considered. Most crop and livestock alternatives required improved management practices.

The authors made the following conclusions for the three farms studied:

1. The income potential for a typical farm with 96 crop acres provided the following guidelines: (1) The most profitable crop rotation was the maximum corn rotation when a large number of cattle were fed. With an increase in milk prices and dairying, more forage was required and the high forage rotation (CCOHH) was most profitable. It was profitable to fertilize crops at the higher (recommended) rates. (2) Increased crop yields from more fertilizer and additional purchased corn could be profitably used to expand size of livestock enterprises. However, expansion was limited by the amount of labor available during winter months. (3) A dairy herd was always part of the most profitable farm organization, even with milk prices as low as $2.50 per cwt. A large number of feeder cattle were profitable with low milk and hog prices. With milk prices of $3.30 per cwt. or higher and hog prices of $15.50 or higher, these enterprises were more profitable. Several of the farm organizations included a large number of feeder pigs. And (4) credit requirements increased substantially for farm organizations requiring purchase of many steers or feeder pigs.
2. The income potential of a farm with a 164-acre cropland base was substantially greater than for the small farm and livestock organization was more flexible. Although dairying was included in most farm plans, it was less necessary than for the small farm. The following generalizations about typical farm one were also valid for typical farm two: (1) It was always most profitable to fertilize crops at the higher (recommended) rate. The most profitable crop rotation was a maximum corn rotation (CCOH) when a large number of cattle were fed. When a large dairy enterprise was included it was profitable to shift part of the acreage to a higher forage rotation. (2) Expansion of livestock was limited by full utilization of labor during winter months. And (3) credit requirements were large for farm organizations with substantial steer and hog-fattening enterprises.
3. For a typical farm with more than 190 acres of crops, it was always profitable to fertilize crops at the recommended rate and to utilize a minimum tillage system of land cultivation. The following general conclusions were made: (1) With a limit of $16,000 or less on real estate credit and no land purchase alternative, and with intermediate hog and milk prices, the most profitable organization was a stanchion dairy-beef operation. This plan included 24 to 28 dairy cows, 208 to 228 yearling steers, and 84 to 155 purchased feeder pigs finished. The income potential was reduced only slightly by eliminating the dairy enterprise, increasing the number of steers from 271 to 278 head, and farrowing 21 to 28 sows on a two-litter

system. And (2) with an increase in credit availability to $25,000 and with milk prices of $3.30 or higher, a specialized loose housing-milking parlor dairy organization was most profitable. This specialized dairy operation included 95 to 96 cows as the only livestock alternative.

U. Minn., Agr. Expt. Sta., St. Paul, Minn.

257. Hunt, D. R. SELECTION OF FARM MACHINERY GUIDELINES FOR CHOOSING ECONOMIC-SIZE IMPLEMENTS. U. Ill., Col. Agr., Coop. Ext. Serv. C. 876, 32 pp. 1963.

Some new and practical guidelines for taking the guesswork out of selecting farm equipment were given.

Farmers usually buy a new piece of equipment with the belief that it will pay for itself either by increasing the efficiency or volume of a profitable enterprise or by reducing production costs. Whether this belief is justified depends largely on how well the machine's capacity is matched to the job.

If capacity is too low, operating costs will be excessive and untimely operations may lower both the quantity and quality of the crop. If capacity is too great, the high fixed costs of the machine make its use unprofitable. An optimum-size machine will occur between these two extremes. But without well-defined guidelines for choosing optimum size, buying machinery has been a highly speculative venture.

The guides presented are applicable when a single type of machine is being selected to fit into an existing farm operation. It is assumed that the selection of one implement does not affect the economy of the other farm machines and that the tractor costs remain constant and independent of the size of implement selected.

It was recommended that the guides presented should not be used to outfit an entire farm although the data may have some value as a basis for estimates.

U. Ill., Col. Agr., Coop. Ext. Serv., Urbana, Ill.

258. Burroughs, W., and Zmolek, W. 62 QUESTIONS ABOUT STILBESTROL ANSWERED. Iowa Agr. and Home Econ. Expt. Sta. B. P-133, 13 pp. 1963.

The first stilbestrol feeding experiment with beef cattle was conducted 10 years ago (1953) at Iowa State University. Since then nearly every state university, many foreign countries, and several feed manufacturers have conducted stilbestrol research. In these studies, essentially all cattle feeding conditions have been explored. Information from more than 100 cattle experiments was used in this review to answer many of the questions posed at different times by different individuals regarding stilbestrol feeding.

Agr. and Home Econ. Expt. Sta. and Coop. Ext. Serv., Iowa State U. Sci. and Tech., Ames, Iowa.

259. Hecht, R. W. LABOR USED TO PRODUCE LIVESTOCK: ESTIMATES BY STATES, 1959. U.S. Dept. Agr., Econ. Res. Serv. Stat. B. 336, 21 pp. 1963.

State estimates of the man-hours of labor used in 1959 for producing the major kinds of livestock were given. Similar estimates are developed every fifth year after data from the agricultural census are available. The quinquennial State estimates are weighted into regional averages, which serve as benchmarks for annual series. Each year the regional averages (man-hours per head or unit of production of livestock, together with comparable data for crops) are applied to the estimates of acres, numbers, and production of crops and livestock, prepared by the State-Federal crop reporting system, Statistical Reporting Service, to arrive at total man-hours of labor used by enterprises, for regions, and for the country as a whole. The total man-hours are converted to indexes which, with comparable indexes of production, are used to compute indexes of production per man-hour. The aggregate man-hours are also used as the labor component in an index measure of total production inputs in farming.

OMS, USDA, Inform. Div., Washington, D.C., 20250

260. McClung, M. R. FEED AND GROWTH STANDARDS FOR COMMERCIAL LAYERS DURING THE GROWING PERIOD. R.I. Agr. Expt. Sta. B. 373, 11 pp. 1963.

Changes in composition of rations, growth rate of breeding combinations, breeding goals for body size, and changes in disease control and management practices of laying strains make it necessary to revaluate standard figures for growth, feed consumption, and feed conversion for laying strains of chickens during the growing period.

Feed consumption and growth rate data were obtained on 17 different breeding combinations in each of 3 years. Forty-four hundred and ten birds (females) were used in the study. The author concluded that:

1. Average age at 50 percent production was 179 days for the heavies and 174 days for the lights.
2. Average weight at 150 days was 4.70 for heavies and 3.38 for the lights.
3. The light breeding combinations required 23.94 pounds of feed per bird to reach 50 percent production. The percentage of feed consumed to the end of the following periods were: 28 days 5.9; 56 days 17.8; 84 days 35.0; 112 days 53.4; 140 days 73.1; 150 days 79.8; and 174 days 100 (which is the average age at 50 percent production). The heavy breeding combinations required 28.39 pounds of feed to reach 50 percent production at 179 days. The percentage by periods was similar to that of the light breeding combinations.
4. Approximately 48 percent of the feed required to reach 50 percent production was consumed after the 16th week, and 21 percent after 150 days of age.
5. The average mortality for the 3-year period was 2 percent.
6. If body weight at 150 days is known, feed consumption can be determined by using the following formula:

   Feed consumption = 10.61 + 2.48 × body weight.

7. The feed requirements for maintenance and growth were similar in all breeding combinations when adjusted for differences in body size.

Agr. Expt. Sta., U. R.I., Kingston, R.I.

261. Davis, K. C., and Mann, R. K. EGG PRODUCTION COST ALTERNATIVES. Okla. State U. Expt. Sta. Proc. Ser. P-463, 58 pp. 1963.

Production process alternatives for commercial poultry (layer) enterprises were examined and the cost relationships of these processes to increases in flock size were evaluated in terms of associated costs.

Least-cost estimates of producing a dozen eggs were made for various employed-labor cost assumptions and operator-managment returns assumptions. The short-run and long-run cost curves derived from these estimates supported the following interpretation of the size and process economies in the layer enterprise.

1. Employed-labor rates did not affect per dozen costs for flock sizes of 1,500 and 3,000 since all labor was preformed by the operator-manager.
2. Total cost per dozen eggs declined rapidly for the flock sizes between 1,500 and 6,000. An increase in flock size from 6,000 to 12,000 did not materially affect production costs per dozen.
3. Total cost per dozen eggs declined more rapidly at high wage rates and operator-management returns. At low wage rates and operator-management returns, costs declined approximately 8 cents for flock size increases from 1,500 to 6,000. For high wage rates and operator-management returns, costs declined approximately 15 cents for flock size increases from 1,500 to 6,000.
4. When all labor was priced at an hourly rate, production cost differences between processes became significant. When all labor, employed or operator-management, was priced at less than 1 dollar per hour, there was no significant difference in production costs between the five processes of production at any given flock size. As wage rates approached $2.50 per hour and as flock sizes increased to 6,000 or 12,000, significant differences in per dozen costs due to process appeared. For flock size of 12,000 and wage rate of $2.50 there was a spread in costs between the high and low cost process of approximately 3.5 cents per dozen.
5. Fixed cost per dozen was reduced about 2 cents per dozen, depending on specific process, as flock size increased from 1,500 to 12,000.
6. Operator-managers of layer enterprises of less than 3,000 birds cannot achieve a per dozen cost level similar or comparable to the level for larger flocks unless the operator-management return to the operator and/or returns to other owned resources are substantially below such returns to operators of larger units.

Two factors affected the ability to repay pullet costs: (1) The average egg price; and (2) the average current operating costs. If egg prices averaged less than 25 cents per dozen, no flock size repaid pullet replacement costs. As flock size increased and egg prices increased, total number of days or total dozen eggs required to repay pullet cost was reduced. An excess of 6 months, after the start of the laying period, was required to repay pullet replacement cost for the 12,000 size flock when egg prices averaged 35 cents.

To expand from 3,000 birds to 12,000 birds, approximately $20,000 was needed. If egg prices averaged 33 cents per dozen, repayment of the $20,000 took about 4 years, but if egg prices dropped to 32 cents per dozen it took approximately 10 years to repay the $20,000.

It was evident that costs were reduced as flock size increased to approximately 6,000. But such expansions of flock size and the resulting output by all producers would create surpluses and/or reduce prices under the present market structure.

Tables.

Okla. State U. Expt. Sta., Stillwater, Okla.

262. Andrilenas, P. A. ECONOMIC ASPECTS OF SPECIFIC PATHOGEN FREE HOG PRODUCTION. U.S. Dept. Agr., Econ. Res. Serv. ERS-142, 14 pp. 1964.

SPF (specific pathogen free) hogs have more feeding efficiency (ratio of meat produced to feed fed) than conventional hogs. When feeding efficiency of conventional hogs is reduced because of atrophic rhinitis and virus pig pneumonia, the farmer would profit by changing to SPF hog production.

The cost of the SPF breeding stock replacement, the outlay for additional equipment, the loss in income from the interruption of hog production, and the cost of the cleanup are the major factors to consider in establishing a SPF herd.

The cost of SPF breeding stock replacements of breeding age is approximately $100 for primary pigs, open secondary gilts, or bred secondary gilts.

The amount of income foregone, due to the cleanup and interrupted hog production affects the choice of a method to convert to SPF hog production. The amount of income lost through interrupted production depends upon the length of time production is curtailed and the profitableness of the conventional hog enterprise.

The importance of lost income is related directly to the amount of profits from the conventional hog enterprise and the time hog production is interrupted.

Lost income from curtailed hog production is reduced: (1) By the purchase of mature breeding stock replacements--secondary gilts rather than primary pigs; or (2) by maintaining two herds until the SPF herd is ready for full production.

Maintaining two herds eliminates time out of production, but other costs will increase. Additional housing and equipment are necessary to care for SPF breeding stock replacements.

If net returns to labor and management are low for the conventional hog enterprise, the farmer can reduce his outlay in converting to SPF hog production by cleaning up existing shelters and equipment before bringing SPF breeding stock replacements on his farm.

Feed costs for SPF hogs are 9.5 percent below feed costs for those conventional hogs which require 450 pounds of feed per hundredweight of live weight to produce. When conventional hogs require 500 and 550 pounds of feed per hundredweight of production, feed costs are, respectively, 22 and 27 percent higher than feed costs for SPF hogs.

The SPF hog production program is predicated on the use of sound production techniques. The SPF hog does not substitute for poor management. The farmer must maintain good sanitation and nutrition. Costs and techniques of production are about the same for SPF herds as for well-managed, clean, conventional herds.

OMS, USDA, Inform. Div., Washington, D.C., 20250

263. Robertson, J. C., and Chaney, C. H. SWINE FEEDING AND MANAGEMENT FROM FARROWING TO WEANING. Ky. Coop. Ext. Serv. C. 591, 15 pp. 1963.

Robertson, J. C., Barnhart, C. E., and Chaney, C. H. SWINE FEEDING AND MANAGEMENT FROM WEANING TO MARKET. Ky. Coop. Ext. Serv. C. 592, 15 pp. 1963.

These two publications contain information regarding the recommended management and feeding practices for hogs from farrowing to weaning. Other factors which determine profits in the swine industry--breeding, housing and equipment, and herd health were briefly discussed.

U. Ky., Coop. Ext. Serv. Agr. and Home Econ., Lexington, Ky.

Institutional, Educational, and Social Factors Affecting Conservation Application

SEE ALSO 8, 12, 206, 244.

264. Nichols, J. M. "OZARK RIVERS"--ECONOMIC DEVELOPMENT AND SINGLE USE PRESERVATION? J. Forestry 62(3): 147-153. 1964.

A 94,000-acre strip of land bordering the Current and Jacks Fork Rivers in the Missouri Ozarks has been proposed as a national recreation area under the administration of the National Park Service. The history of land use change in this area was traced, including exploitation of the timber resource, results of rehabilitation efforts, attempts to dam the streams, and recent proposals aimed at preservation of the landscape and economic development of the region. The validity of studies justifying an "Ozark National Rivers" was questioned and alternative means of reaching preservation objectives were explored.

The question was raised whether economic development, using recreation as the vehicle, and single-use preservation were compatible land management objectives. The central idea presented revolves around the fact that extensive forest management practices have improved the naturalness of the landscape while the area has concurrently served several use demands.

U. Mo., Columbia, Mo.

Soil Conservation. 29(10): 219-239. 1964.

The May issue of Soil Conservation was devoted to articles on soil stewardship and soil conservation. The following list gives the authors, title, and address of author of each article.

265. Williams, D. A. SOIL STEWARDSHIP WEEK. SCS, USDA, Washington, D.C., 20005

266. Achtermann, A., and Decker, L. R. "A BETTER WORLD" IS ONE AIM OF VACATION FARMS FOR CITY PEOPLE. SCS, USDA, Millersburg, Ohio.

267. Willis, R. GREAT PLAINS CONSERVATION PROGRAM REPRESENTS GOOD SOIL STEWARDSHIP. SCS, USDA, Lubbock, Tex.

268. Roth, B. A. SOIL SURVEYS BASIS FOR GOOD SOIL STEWARDSHIP. SCS, USDA, Upper Darby, Pa.

269. Eberhart, P. PASSION PLAY DIRECTOR ALSO GOOD SOIL STEWARD. SCS, USDA, Denver, Colo.

270. Williams, D. A. NEW HORIZONS IN CONSERVATION: EXCERPTS FROM THE 1963 ANNUAL REPORT ON THE SOIL CONSERVATION SERVICE. SCS, USDA, Washington, D.C., 20005

271. Freeman, O. L. LAND TODAY HAS NEW VALUES. USDA, Washington, D.C., 20005

272. Sasser, J. R. GIRL SCOUT COOKIES HELP BUILD "SWEETEST LAKE IN THE WORLD". SCS, USDA, Nashville, Tenn.

273. Allen, W. S. PEOPLE'S SOULS AND SOILS--BOTH CONCERN GEORGIA MINISTER. No address given.

274. Smith, G. S. DELAWARE BEACH OWNER STOPS WAVES' DAMAGES. SCS, USDA, Upper Darby, Pa.

Soil Conservation. 29(8): 171-192. 1964.

The March issue of Soil Conservation was devoted to articles on the effects of conservation on recreation facilities and wildlife. The following list presents the author, title, and address of author of each article.

275. Williams, D. A. RECREATION HAS IMPORTANT PART IN LAND'S USE AND CONSERVATION. SCS, USDA, Washington, D.C., 20005

276. Holland, J., and Allen, W. S. ALABAMA BROTHERS SWITCH FARM FROM ROW CROPS TO RECREATION. SCS, USDA, Geneva, Ala.

277. Kline, D. D., and Bureau, M. F. IT'S MAPLE SYRUP TIME AGAIN! SCS, USDA, Grand Rapids, Mich.

278. Roth, B. A. MASSACHUSETTS CAMPERS LEARN ABOUT RESOURCES--CONSERVATION. SCS, USDA, Upper Darby, Pa.

279. Allen, W. S. GEORGIA CONSERVATION FARM LAKE SERVES PEOPLE OF FOUR COUNTIES. SCS, USDA, Spartanburg, S.C.

280. Halloran, A. F., and Buchmeier, R. H. CONSERVATION INCREASES FEED FOR HUNGRY TETON ELK HERD. Bur. Sport Fisheries and Wildlife, U.S. Dept. Int., Cache, Okla.

281. Skaife, C. W. HE HOLDS WATER ON THE LAND FOR THE SAKE OF WILDLIFE. SCS, USDA, Waukesha, Wis.

282. Ramsey, N. L. BIRD FEEDING LEADS VIRGINIAN INTO HUNTING LODGE BUSINESS. SCS, USDA, Charlotte Court House, Va.

283. Stubbe, G. F. WASHINGTON STATE RANCHER ADDS RECREATION AND WILDLIFE. SCS, USDA, Wenatchee, Wash.

284. Archer, S. G. FARM PONDS IN SMOKIES' SHADOW YIELD TROUT FOR FUN AND PROFIT. SCS, USDA, Spartanburg, S.C.

285. Bell, E. L. KANSAS WATERSHED LAKE GIVES UP RECORD BASS. SCS, USDA, Sedan, Kans.

286. Mulvaney, F. E. PAY-AS-YOU-SHOOT HUNTERS PAY OFF FOR NEW YORK FARMER. SCS, USDA, Cortland, N.Y.

BIOLOGY

Fish

SEE ALSO 206, 248, 284, 285, 298.

287. Flick, W. A., and Webster, D. A. COMPARATIVE FIRST YEAR SURVIVAL AND PRODUCTION IN WILD AND DOMESTIC STRAINS OF BROOK TROUT (SALVELINUS FONTINALIS). Amer. Fisheries Soc. Trans. 93(1): 59-69. 1964.

Brook trout (Salvelinus fontinalis) from three wild populations were compared with domesticated hatchery strains with respect to growth, survival, and production in semi-natural environments (drainable ponds). Eggs from all strains were hatched and reared in the hatchery and planted as spring or fall fingerlings. Over-summer survival consistently favored wild strains (65 to 76 percent compared with 43 to 53 percent survival for domestic strains). Over-winter survivals were not different, although the effect may have been masked by other overriding factors in the test waters. Domestic strains maintained the initial size advantages held at planting. Larger size at planting was due to faster growth rate during hatchery existence. Net production, based on recovery weight less stocking weight, was similar for wild and domestic groups during the over-summer period (higher survivals in wild strains balanced by size advantage of domestic), but domestic groups generally showed lower production or net losses in the over-winter period.

Dept. Conserv., Cornell U., Ithaca, N.Y.

288. Clugston, J. P. GROWTH OF THE FLORIDA LARGEMOUTH BASS (MICROPTERUS SALMOIDES FLORIDANUS (LeSUEUR)), AND THE NORTHERN LARGEMOUTH BASS, (M. S. SALMOIDES (LACEPEDE)) IN SUBTROPICAL FLORIDA. Amer. Fisheries Soc. Trans. 93(2): 146-154. 1964.

Three ponds near Fort Lauderdale, Fla. were stocked with Florida largemouth bass fingerlings in April 1960. In July 1960, two ponds were stocked with northern largemouth bass fingerlings imported from Iowa. Samples of the bass were collected every month from each pond to: (1) Investigate the seasonal pattern of growth of the largemouth bass; (2) determine possible differences in growth rates related only to the advent of sexual maturity; and (3) determine whether or not these subspecies would show differences in growth rate when grown under similar conditions in Florida.

Temperature conditions in south Florida appear to be suitable for growth of the largemouth bass the year around. Both subspecies grew very fast in the study ponds. The northern form grew more rapidly than the southern bass during the early life history, but temperature differences could account for this difference in growth. The northern bass did not become mature during the experiment and the southern form matured at about 9 months of age. The length-weight relationship of the bass populations differed although there was no evidence that these were related to the subspecies. All of the bass populations exhibited high condition factors for most of the year and, in general, the populations that consistently exhibited the highest condition factors grew faster than those with lower condition factors.

Game and Fresh Water Fish Comm., Leesburg, Fla.

289. Horak, D. L., and Tanner, H. A. THE USE OF VERTICAL GILL NETS IN STUDYING FISH DEPTH DISTRIBUTION, HORSETOOTH RESERVOIR, COLORADO. Amer. Fisheries Soc. Trans. 93(2): 137-145. 1964.

The depth distribution of four fishes was studied using specially constructed vertical gill nets on Horsetooth Reservoir, Colo. (1960-61). Of several environmental factors measured, water temperature was the one factor that exerted a measurable effect. Depth of capture increased for the rainbow trout, kokanee salmon, and white sucker as each summer progressed and in general followed the isotherms. The distribution of yellow perch was unaffected by temperature changes. Kokanee salmon were most abundant in waters of 51-55° F. while the rainbow trout and white suckers were most numerous in 66-70° F waters.

Colo. Game, Fish and Parks Dept., Fisheries Res. Cent., Fort Collins, Colo.

290. Hooper, F. F., and Ball, R. C. RESPONSES OF A MARL LAKE TO FERTILIZATION. Amer. Fisheries Soc. Trans. 93(2): 164-173. 1964.

A shallow marl lake was fertilized during 3 consecutive years with inorganic fertilizer. Application was made in midsummer and evaluation of its effect was made by comparing data gathered in a pretreatment and a posttreatment period each year. Fertilization brought about an immediate increase in suspended solids and a decrease in transparency. These changes appeared to be caused by a coalescense of suspended marl rather than by chemical precipitation or by an increase in phytoplankton. A large fraction of the added phosphorus disappeared from the water along with the suspended marl. When solids were separated from the water with a centrifuge, an increase in the organic fraction of the solids after fertilization was not detected. However, during the third year of the study, a small increase was noted when a Millipore filter was employed. Inorganic nitrogen and phosphorus remained in the water for a very short period; however, an organic phosphorus fraction persisted 25 days or more.

In 1954, and 1955, living phytoplankton cells in solids separated from the water either before or after fertilization were not detected when a Foerst centrifuge was used to separate suspended matter. In 1956, a sparse flora of nannoplankton was concentrated from the water using a Millipore filter, and the number of nannoplankton genera increased following fertilization. This response was weak and did not affect the transparency of the lake water. Fertilization brought about a well-marked increase in the production of periphyton algae in all 3 years. The data suggest that benthic algae were more effective than planktonic algae in utilizing nutrients added to marl lakes.

Inst. Fisheries Res., Mich. Dept. Conserv., Ann Arbor, Mich.

291. Smith, L. L., Jr., and Kramer, R. H. THE SPOTTAIL SHINER IN LOWER RED LAKE, MINNESOTA. Amer. Fisheries Soc. Trans. 93(1): 35-45. 1964.

The spottail shiner (Notropis hudsonius (Clinton)) is the most abundant minnow in the Red Lakes, Minn., and is a major food of the walleye (Stizostedion vitreum vitreum), the most important commercial and sport fish in these lakes.

On the basis of 14,654 spottail shiners from Red Lakes, Minn., growth rates, strength of year classes, and food utilization were studied. Males and females had different body-scale relationships, and females grew faster than males. There was a high correlation between water temperature and growth rate. Strength of year classes was closely related to size of spawning population. Food habits were related to food availability in both plankton and bottom fauna. Shiner eggs were significant items of food in larger shiners. Bottom organisms were selectively taken, and larger cladocerans were selected by large fish. Cladocerans were preferred to copepods.

U. Minn., St. Paul, Minn.

292. Krumholz, L. A., and Minckley, W. L. CHANGES IN THE FISH POPULATION IN THE UPPER OHIO RIVER FOLLOWING TEMPORARY POLLUTION ABATEMENT. Trans. Amer. Fisheries Soc. 93(1): 1-5. 1964.

The abatement of pollution in the upper Ohio River following closure of the steel industries on July 15, 1959, led to a marked improvement in water quality accompanied by a rapid increase in the variety and abundance of fishes. Collections of fishes with rotenone from the auxiliary lock chamber at Montgomery Lock and Dam yielded more than twice as many different kinds and more than five times as many individuals within 11 days after the beginning of the steel strike than comparable samples taken from the same area before the strike. The principal difference in species composition was the occurrence of "clean-water fishes" that invaded the previously polluted area, probably from nearby unpolluted waters.

U. Louisville, Louisville, Ky.

293. Burdick, G. E., Harris, E. J., Dean, H. J., Walker, T. M., Skea, J., and Colby, D. THE ACCUMULATION OF DDT IN LAKE TROUT AND THE EFFECT ON REPRODUCTION. Amer. Fisheries Soc. Trans. 93(2): 127-136. 1964.

Hatchery losses of lake trout fry from areas of high DDT use led to a 4-year study of the accumulation of the chemical in fish flesh and eggs from a number of waters in New York. Graphs were presented to indicate the range of DDT content of ether-extracted oils from spawning female lake trout and a comparison of the amount in the oil of the adult with that in the eggs. No constant relationship was found. A procedure was described to relate the mass of the fry at the time of development of the snydrome associated with the mortality to the DDT in the ether-extracted oil of the eggs. Graphical plotting of the concentration in the mass of the fry shows a relatively close relationship between the p.p.m. of DDT and the mortality.

N.Y. State Conserv. Dept., Albany, N.Y.

Upland Wildlife

SEE ALSO 206, 248, 280, 281, 282, 283, 286.

294. Thomas, J. R., Cosper, H. R., and Bever, W. EFFECTS OF FERTILIZERS ON THE GROWTH OF GRASS AND ITS USE BY DEER IN THE BLACK HILLS OF SOUTH DAKOTA. Agron. J. 56(2): 223-226. 1964.

The effects of lime and N fertilization on yield, mineral composition, and deer grazing preference of forage were investigated.

The application of N fertilizer significantly increased forage yields and the N, P, Ca, and K concentration of the forage. The degree of grass response to the N addition was dependent on the indigenous soil nutrient level, especially the Ca-saturation percentage.

Liming significantly raised the percentage of Ca in the forage but had little effect on the other nutrients or on forage yield. However, the addition of lime did increase the absorption of fertilizer N.

Deer preference for nitrogen-fertilized grass was associated with an increase in nutritional value and succulency of the forage.

The peak period of grazing by deer was reached 1 week earlier on the fertilized plots and was maintained over almost twice as long a period of time.

SWCRD, ARS, USDA, Weslaco, Tex., 78596

295. McCullough, D. R. RELATIONSHIP OF WEATHER TO MIGRATORY MOVEMENTS OF BLACK-TAILED DEER. Ecology 45(2): 249-256. 1964.

A study of the influence of weather factors on the migrations of a herd of black-tailed deer showed that periods of migration as indicated by night spotlight samples were closely correlated with seasonal changes in minimal relative humidity. Both spring and fall migrations, and possibly an atypical summer movement, occurred during ranges of 40 to 60 percent minimal relative humidity. Snowstorms, rainfall, absolute humidity, and temperature were not so closely correlated. The migrations could not be attributed to habitat factors such as food, water, or escape cover.

Oreg. Coop. Wildlife Res. Unit, Corvallis, Oreg.

SEE ALSO 206, 248, 281, 283.

296. Orlob, G. T., and Woods, P. C. LOST RIVER SYSTEM--A WATER QUALITY MANAGEMENT STUDY. J. Hydraul. Div., ASCE 90 (HY 2): 1-22. Mar. 1964.

Substantial kills of wild fowl on Northern California refuges directed attention to use of agricultural pesticides and the recycling of irrigation waters in the Lost River System. This complicated water use-reuse scheme, serving 200,000 irrigable acres, was simulated with an electronic computer program capable of processing, in sequence, montly data for precipitation, water supply, consumptive use, and drainage for 11 major subdivisions of the system. Reuse factors, considered to be indicative of relative concentrations of conservative pollutants, were determined for critical operation periods at key points and were found to reflect the potential for build-up of pesticides in the terminal sumps.

U. Calif., Davis, Calif.

297. Ames, P. L., and Mersereau, G. S. SOME FACTORS IN THE DECLINE OF THE OSPREY IN CONNECTICUT. Auk. 81: 173-185. 1964.

The Osprey (Pandion haliaetus) is an inviting subject for ecological study, with its exposed and often gregarious nesting, and its conspicuous feeding behavior. In many parts of the world, the Osprey nests in loose colonies of a few to several hundred pairs.

The breeding population of Ospreys along the Connecticut River in Middlesex and New London counties, Connecticut, has decreased from about 200 pairs in the early 1940's, to 71 pairs in 1960, and 24 pairs in 1963.

The use of elevated nesting platforms has effectively protected marsh-nesting birds against egg losses from predation and tidal flooding.

The main factor contributing to the decrease of the population has been the failure of a high percentage of the eggs to hatch. Nestling losses have been small.

Seven eggs analyzed for the presence of DDT compounds averaged 555 micrograms of metabolities (about 35-100 p.p.m.) per egg, and traces of DDT.

A 5-day-old nestling, killed by a fall from the nest, contained 624 micrograms (15.9 p.p.m.) of metabolities and traces of DDT.

Three samples of fish tissue from Osprey nests contained 1.8-7.4 p.p.m. of metabolities and 0.7-1.8 p.p.m. of DDT.

Available evidence does not provide conclusive proof that DDT compounds have contributed to the failure of Osprey eggs to hatch.

Low nestling production, comparable to that found in the study area, appears to be a major factor in the decline of Ospreys in other parts of southern New England and on Long Island.

Peabody Mus. Natl. Hist., New Haven, Conn.

298. Jensen, L. D., and Gaufin, A. R. EFFECTS OF TEN ORGANIC INSECTIDES ON TWO SPECIES OF STONEFLY NAIADS. Amer. Fisheries Soc. Trans. 93(1): 27-35. 1964.

Aquatic animals are particularly susceptible to insecticide poisoning. Aquatic insects are known to be affected by lower concentrations of pollutional substances than fish and waterfowl. This response has stimulated investigators to attempt to use these organisms as indicators of the bottom fauna to organic pollutants such as synthetic pesticides.

Two species of stonefly naiads were exposed to the chlorinated hydrocarbons DDT, aldrin, dieldrin, and endrin and to the organic phosphates parathion, malathion, guthion, Dylox, Di-Syston, and Bayer-29493. After the introduction of the pesticide, tests were run for 96 hours with observations made after each 24-hour period. There was a definite increase in mortality for both Pteronarcys californica and Acroneuria pacifica with increasing exposure time. Higher concentrations of insecticides produced higher death rates more rapidly than lower concentrations. There were definite symptoms of poisoning noted during the 4-day bioassays. The symptoms did not vary for the two species of stonefly naiads. Animals displaying tremors or convulsions usually died within 24 hours. Both species could recover from the effects of the poisons if they were removed from the solutions of toxicant before the tremors began. Removal from the test solution after the onset of tremors did not prevent death. With the same insecticide, the resistance of P. californica was greater than that of A. pacifica. Larger speciments of P. californica were more resistant than smaller specimens.

U. Utah, Salt Lake City, Utah.

SUPPLEMENT

Problems Indirectly Affecting the Application of Soil and Water Conservation Practices

SEE ALSO 99, 100, 148, 152, 185, 189, 190, 202, 206, 213, 224, 225, 226, 292, 293, 296, 297, 298.

299. Wiese, A. F., and Davis, R. G. HERBICIDE MOVEMENT IN SOIL WITH VARIOUS AMOUNTS OF WATER. Weeds 12(2): 101-103. 1964.

When applied in enough water to wet tubes of dry Pullman sicl top soil to a depth of 22 inches, dimethylamine salts of 2,3,6-TBA and PBA were leached to about 20 inches; an amine salt of 2,4-D and the sodium salt of fenac leached to 15 inches; esters of fenuron, and amine salts of silvex and 2,4,5-T leached to approximately 9 inches. Esters of silvex, 2,4,5-T, and 2,4-D remained in the top 3 inches of soil. The leaching with additional water was in the same general order.

Tex. Agr. Expt. Sta., College Station, Tex.

300. Muzik, T. J., and Mauldin, W. G. INFLUENCE OF ENVIRONMENT ON THE RESPONSE OF PLANTS TO HERBICIDES. Weeds 12(2): 142-145. 1964.

Absorption and translocation of herbicides in both leaves and roots was less under low temperatures. Seasonal response of wheat to 2,4-D was conditioned by the stage of growth as well as environment. The response of wheat and downy bromegrass to triazine herbicides was seasonal, whereas the response to carbamate herbicides appeared to be influenced by local environmental conditions at the time of spraying. Physiological condition of fiddleneck was more important than age, i.e., plants in the rosette stage were always far more sensitive than bolting plants of the same age. Sensitivity to 2,4-D was greater at 26° C. than at 10° C. or 5° C. at all stages of growth. Applications of certain metabolites, especially thiamin, increased the sensitivity of fiddleneck to 2,4-D at low temperatures.

Wash. Agr. Expt. Sta., Pullman, Wash.

301. Ross, R. G., and Stewart, D. K. R. MERCURY RESIDUES IN POTATOES IN RELATION TO FOLIAR SPRAYS OF PHENYL MERCURY CHLORIDE. Canad. J. Plant Sci. 44(2): 123-125. 1964.

When different numbers of sprays of MCO (mercurized copper oxychloride) were applied to potato foliage at different times during the growing season, the accumulation of mercury in the foliage was approximately proportional to the number of sprays and the interval following application. This relationship did not apply to the mercury residues in the tubers where the mercury accumulated during the period of rapid increase in tuber size. Varying the number of sprays early in the season did not significantly change the amount of mercury in the tubers but smaller tuber residues were present where only late sprays were applied. Mercury appeared to accumulate in the tubers by translocation from the foliage.

Res. Sta., Canada Dept. Agr., Kentville, Nova Scotia, Canada.

302. Negi, N. S., Hunderburk, H. H., Jr., and Davis, D. E. METABOLISM OF ATRAZINE BY SUSCEPTIBLE AND RESISTANT PLANTS. Weeds 12(1): 53-57. 1964.

Metabolism of C-14-labeled and unlabeled atrazine was studied in oats, soybeans, and beans (susceptible); cotton and peanuts (intermediate in susceptibility); and Johnsongrass, grain sorghum, and corn (resistant). Atrazine residues were found in all plants 11 days after preemergence application of 1 lb. atrazine/A.

Undegraded atrazine found in plants was roughly correlated with susceptibility, but atrazine absorption was not directly correlated with plant susceptibility. Radioactivity remaining in plant residue after methanol extraction likewise was not completely correlated with susceptibility. All plants converted some atrazine to hydroxyatrazine and the amount of hydroxyatrazine formed was somewhat correlated with resistance. The three resistant species converted at least twice as much atrazine to hydroxyatrazine as did the susceptible soybean and oats. Beans converted considerably larger amounts of atrazine that did other susceptible species.

Auburn U., Agr. Expt. Sta., Auburn, Ala.

303. Holly, K., and Roberts, H. A. PERSISTENCE OF PHYTOTOXIC RESIDUES OF TRIAZINE HERBICIDES IN SOIL. Weed Res. 3(1): 1-10. 1963.

A bioassay technique for the determination of phytotoxic residues of triazine herbicides and monuron in soil from field plots was described. The effect of a dilution series with untreated soil on shoot growth of Italian ryegrass (Lolium multiflorum Lam.) was compared with that in a corresponding assay at the time of application of the herbicide. This method was used to compare the persistence of residues of simazine, propazine, prometon, and monuron, and to compare persistence in 3 years and in three soil types. The time required to disappearance of 80 percent of the activity following application of 1 lb./A. of simazine varied from 7 to 27 weeks, according to the year. Prometon was the most persistent of the triazines tested.

Agr. Res. Council, Weed Res. Organ., Kidlington, Oxford, England.

304. Talbert, R. E., and Fletchall, O. H. INACTIVATION OF SIMAZINE AND ATRAZINE IN THE FIELD. Weeds 12(1): 33-36. 1964.

The toxicity of simazine and atrazine to eight crops was determined. The crops in order of increasing tolerance to these herbicides were Southern Giant Curled mustard, Missouri 0-205 oats, Straight Eight cucumbers, Knox wheat, Clark soybeans, RS610 grain sorghum, GT-112 inbred corn, and F-6 inbred corn. Inactivation of simazine and atrazine applied at 2 lb./A. on field plots, as determined by soybean and oat bioassay, was more rapid when the soil environment was favorable for the growth of microorganisms. Very little inactivation occurred between September, 1960, and June, 1961, following a May 1960, application. One year after application, 0.16 lb./A of atrazine and 0.31 lb./A. of simazine were detected, but neither was detected after 16 months.

U. Ark., Fayetteville, Ark.

305. Kearney, P. C., Sheets, T. J., and Smith, J. W. VOLATILITY OF SEVEN s-TRIAZINES. Weeds 12(2): 83-87. 1964.

Volatilities of 2-chloro-4,6-bis(ethylamino)-s-triazine [simazine], 2-chloro-4-ethylamino-6-isopropylamino-s-triazine [atrazine], 2-chloro-4, 6-bis(isopropylamino)-s-triazine [propazine], 2-methoxy-4,6-bis(isopropylamine)-s-triazine [prometone], 2-ethylamino-4-isopropylamino)-6-methylmercapto-s-triazine [ametryne], 2-4-bis-(isopropylamino)-6-methylmercapto-s-triazine [prometryne], and 2-chloro-4-diethylamino-6-ethylamino-s-triazine [trietazine] were studied at different temperatures. In descending order at 25° C., the relative volatilities of the herbicides from nickel-plated planchets were prometone ≅ trietazine > atrazine ≅ ametryne ≅ prometryne > propazine ≅ simazine. Prometone losses from five soils appeared to be directly related to percent sand and inversely related to percent clay and organic matter. Atrazine and simazine losses from the same soils appeared to be less influenced by soil properties than prometone. All seven s-triazines were examined at one temperature on wet and dry Tifton ls. Moisture level affected both the amount of compound lost and the relative order of loss among compounds. Conversion of atrazine and prometone to their corresponding hydroxy analogues was a practical method for preventing vapor losses from planchets.

CRD, ARS, USDA, Beltsville, Md., 20705

306. Birk, L. A., and Roadhouse, F. E. B. PENETRATION OF AND PERSISTENCE IN SOIL OF THE HERBICIDE ATRAZINE. Canad. J. Plant Sci. 44(1): 21-27. 1964.

The soil penetration and persistence of atrazine applied to a loam soil in June, 1960, and again to a second series of plots in June, 1961, at rates ranging from 2 to 20 lb./active/A. were studied. A few of the plots were planted to corn; the rest left fallow. Residual concentrations at 0-1 in., 1-2 in., 2-4 in., 4-6 in. and 6-8 in. were determined by chemical analysis.

At the end of the first sampling season, approximately 90 percent of the residual atrazine was present in the 0-2 in. depth, most still being concentrated in the 0-1 in. layer. One year after treatment, the above was still true except for those plots which had grown corn.

At the end of the first sampling season there was an appreciably greater residue remaining in the corn plots than in the similarly treated fallow plots, the average for both experiments was 43.8 percent of applied atrazine vs. 18.3 percent. The difference was probably due to the much drier soil which was characteristic of the corn plots during the season. By the end of the first year, this difference was much less, 8.1 percent vs. 6.0 percent.

Ontario Agr. Col., Guelph, Ontario, Canada.

307. Palmer, L. M. WHAT'S NEW IN MANURE DISPOSAL. Agr. Engin. 45(3): 134-135. $0.50. 1964.

A summary of the 7 papers dealing with disposal of manure that covers 12 different methods that are being tested and used for poultry, dairy, and swine was given. The following seven papers presented at the session can be purchased at 50 cents each.

308. Ostrander, C. E. WHAT'S GOING ON IN POULTRY MANURE DISPOSAL. Cornell U., Ithaca, N. Y., ASAE Paper No. 63-916.

309. Wolf, D. C. WHAT'S GOING ON THE HOG MANURE DISPOSAL. Editor, Hog Extra Edition, Farm Journal. Ames, Iowa. ASAE Paper No. 63-917.

310. Johnson, C. A. WHAT'S GOING ON IN DAIRY MANURE DISPOSAL. U. Mass., Amherst, Mass. ASAE Paper No. 63-918.

311. Jeffrey, E. A. WHAT IS TAKES TO MAKE A LAGOON WORK. U. Mo., Columbia, Mo. ASAE Paper No. 63-919.

312. Day, D. L. GASES AND ODORS ENCOUNTERED IN CONFINEMENT SWINE BUILDINGS. U. Ill., Urbana, Ill. ASAE Paper No. 63-920.

313. Ludington, D. C. INCINERATION AND DEHYDRATION OF POULTRY MANURE. Cornell U., Ithaca, N.Y. ASAE Paper No. 63-921.

314. Hart, S. A. PRODUCING ALGAE IN LAGOONS. U. Calif., Davis, Calif. ASAE Paper No. 63-922.

Individual papers for sale by ASAE, 420 Main St., St. Joseph, Mich., 49085

315. Daniel, E. R. BASIC PARAMETERS FOR RAPID TREATMENT OF POND WATER FOR DOMESTIC USE. Trans. ASAE 7(1): 44-45. 1964.

Design parameters for pressure filters for the rapid treatment of farm pond waters were determined from research results. Excellent clarification of finished water occurred in the 12 ponds tested when run within the specified limits. Some 95 to 100 p.p.m. alum, or 4 to 6 times the amount used in gravity sand filtration, was required for quick flocculation regardless of raw water turbidity. In most runs, the pH of finished water was less than 7.0 which required the addition of potash or other alkali.

Okla. State U., Stillwater, Okla.

Radioactive Fallout

SEE ALSO 77.

316. Evans, S. D., and Barber, S. A. THE EFFECT OF CATION-EXCHANGE CAPACITY, CLAY CONTENT, AND FIXATION OF RUBIDIUM-86 DIFFUSION IN SOIL AND KAOLINITE SYSTEMS. Soil Sci. Soc. Amer. Proc. 28(1): 53-56. 1964.

An investigation of the factors influencing the diffusion of Rb-86 in eight soils showed that the more strongly Rb-86 was absorbed by the soils the slower was the rate of diffusion. In leached soils that were dried after labeling, diffusion was correlated with the amount of Rb-86 fixed against NH_4OAc extraction. In leached soils that were kept moist after labeling, diffusion was closely related to clay content with exchange capacity. In dilute kaolinite systems, diffusion was related to the amount of Rb-86 in solution.

West Central Expt. Sta., U. Minn., Morris, Minn.

317. Evans, S. D., and Barber, S. A. THE EFFECT OF RUBIDIUM-86 DIFFUSION ON THE UPTAKE OF RUBIDIUM-86 BY CORN. Soil Sci. Soc. Amer. Proc. 28(1): 56-57. 1964.

Uptake of Rb-86 by corn roots was highly correlated with the diffusion of Rb in soil and kaolinite systems. At values of Dp/b above 1×10^{-8} cm.^{2}sec.$^{-1}$, the relationship was curvilinear whereas it was more nearly linear at rates less than this. The curvilinear relation at the higher rates of diffusion was attributed to the limitations of the rate of absorption of the root.

West Central Expt. Sta., U. Minn., Morris, Minn.

318. Smith, R. E., and Dixon, E. H., Sr. ABSORPTION CHARACTERISTICS OF SOILS FOR COBALT 60 GAMMA RAYS. Trans. ASAE 6(3): 209-212. 1963.

The mass absorption coefficients for soil materials and Co-60 gamma rays were measured for a range of soil types, bulk densities, organic matter contents, and moisture contents. The values were remarkably constant for all the variable changes including a change in moisture content of from air dry to 30 percent moisture. In comparison, the generally accepted combination rule for obtaining effective values of this constant for compounds and mixtures of elements predicts an increase of about 1 percent for each 10 percent of water content (wet-weight basis). The average mass absorption coefficient for soil materials and Co-60 gamma rays were 0.0584 cm^2/g. with a fractional standard deviation of 0.58 percent.

The build-up factor for counting rate for a point source of Co-60 gamma rays and soil materials was measured for a range of mean free paths of from 2.88 to 5.21. Most of these measurements were made with an absorber thickness of 43.18 cm. and for a range of bulk densities of from 1.17 to 2.07 g./cm^3.

U. Ga., Athens, Ga.

INDEX TO AUTHORS
(Figures refer to index number)

Achtermann, A., 266
Alderfer, R. B., 39
Alexander, M., 217
Allen, W. S., 233, 273, 276, 279
Allred, K. R., 149
Alverson, K., 5
Ames, P. L., 297
Anderson, D. J., 231
Anderson, D. T., 179
Andrilenas, P. A., 262
Apmann, R. P., 4
Archer, S. G., 227, 284
Aristovskaya, T. V., 89
Armbrust, D. V., 131
Armstrong, R. W., 101
Army, T. J., 215
Ashley, D. A., 41, 59
Atkinson, W. O., 164
Aubertin, G. M., 63

Bagley, W. T., 208
Baker, D. E., 102
Baker, J. A., 245
Ball, R. C., 290
Ballantyne, A. K., 121
Barber, S. A., 86, 316, 317
Barnhart, C. E., 263
Bartholomew, W. V., 95
Basaraba, J., 160
Batchelder, A. R., 167
Bay, C. E., 178
Beach, D. B., 12
Beardsley, D. W., 108
Beer, C. E., 139
Bell, E. L., 285
Bellard, C., 244
Bennett, O. L., 41, 59
Bernstein, L., 166
Bever, W., 294
Bhar, D. S., 209
Birch, H. F., 93
Birk, L. A., 306
Bishop, R. F., 97, 116
Bittinger, M. W., 27
Boatwright, G. O., 159
Boddy, H., 10
Bond, J. J., 215
Bornstein, J., 53
Bouwer, H., 46, 71
Bovey, R. W., 153
Bowie, A. J., 17
Bowns, J. E., Jr., 194
Box, T. W., 194
Brady, N. C., 110
Brandt, G. H., 94
Brehm, C. D., 56
Brown, C. B., 1
Brown, D. A., 68
Brown, H. M., 214
Brown, J. C., 105
Bryan, B. B., 68
Buchmeier, R. H., 280
Buglass, E., 201
Burdick, G. E., 293
Bureau, M. F., 277
Burnside, O. C., 218
Burroughs, W., 258
Burton, G. W., 108

Cain, J. C., 210
Calder, F. W., 97
Caldwell, A. G., 75
Carson, R. B., 106
Chandra, P., 99
Chaney, C. H., 263
Changnon, S. A., Jr., 20
Chapin, J. S., 75
Chase, F. E., 98
Chepil, W. S., 131
Chesters, G., 74
Chisholm, D., 226
Clark, F. E., 62
Clark, J. S., 73
Clark, R. E., 111
Clayton, J. S., 121
Clugston, J. P., 288
Clutter, J. L., 69
Colby, D., 293
Colville, W. L., 218
Colvin, J., Jr., 236
Cook, D. B., 140
Cooper, C. S., 183
Coppock, G. E., 211
Corder, G., 164
Corke, C. T., 98
Cornfield, A. H., 80
Cosper, H. R., 294
Coupland, R. T., 127, 147
Crampton, B., 199
Cross, J. M., 239
Curley, R. G., 192
Curtis, G. H., 125

Dagan, G., 48
Dailey, R. M., 246
Daniel, E. R., 315
Davis, D. E., 150, 191, 302
Davis, J. F., 117
Davis, J. R., 37, 38
Davis, K. C., 261
Davis, R. G., 299
Davis, S. N., 19
Day, D. L., 312
Day, L. M., 256
Dean, H. J., 293
Decker, L. R., 266
Decker, R. S., 229
DeRemer, E. D., 103
Dixon, E. H., Sr., 318
Dixon, R. M., 178
Dobie, J. B., 109, 192
Dodd, J. D., 127
Donath, F. A., 126
Doss, B. D., 41, 59
Dotzenko, A. D., 107
Douglass, J. E., 69
Dowler, C. C., 219
Driel, W. Van., 163
Dubetz, S., 143
Duke, G. B., 217
Dvoracek, M. J., 26
Dwyer, D. D., 186

Eberhart, P., 269
Ellis, R., Jr., 117
Engelbert, L. E., 74
Erickson, A. E., 94
Evans, S. D., 316, 317
Evernden, J. F., 125

Fanning, C. D., 169
Farrell, D. A., 32
Fedde, G. F., 206
Fellows, M., 84, 85
Fenster, C. R., 153
Ferguson, H., 159, 183
Ferguson, W. S., 171
Findlay, W. I., 113

Finney, E. E., 223
Fisher, F. L., 75
Fleming, A. L., 87
Fletchall, O. H., 304
Flick, W. A., 287
Fly, C. L., 130
Foth, H. D., 214
Fox, C. J. S., 190, 226
Fox, R. L., 43
Foy, C. D., 105
Freeman, O. L., 245, 271
Francis, C. J., 227
Francois, L. E., 166
Frazier, A. W., 81
Frost, K. R., 29
Fruktova, N. I., 92
Fryrear, D. W., 137
Fuehring, H. D., 114
Fulton, J. M., 113
Funderburk, H. H., Jr., 57, 150, 191
Fuqua, J. E., 255

Gallagher, P. A., 95
Gallatin, M. H., 167
Gamble, M. D., 200
Gardner, W. R., 65
Gasser, J. K. R., 155
Gaufin, A. R., 298
Geering, H, R., 85
Gibson, G., 242
Gilliam, J. W., 252
Gomm, F. B., 182
Gorsline, G. W., 63, 102
Goss, J. R., 109
Gray, A. S., 34
Green, R. E., 64
Gressel, J. B., 146
Grover, B. L., 76
Grube, W. E., 102
Guest, R. W., 210
Gurney, E. L., 78

Halkias, N. A., 28
Hall, C. W., 223
Halloran, A. F., 280
Halstead, R. L., 82
Hamilton, H. A., 158
Hanks, R. J., 64
Harpstead, M., 128
Harris, E. J., 293
Harris, W. S., 54
Hart, S. A., 165, 314
Hart, W. E., 37
Hays, O. E., 178
Healey, L. R., 241
Heard, W. L., 6
Hecht, R. W., 259
Heilman, M. D., 52
Henderson, K. E., 107
Hermann, R. K., 177
Hewlett, J. D., 69
Hill, K. W., 115, 143
Hilton, R. J., 209
Hinman, W. C., 91
Hobbs, E. H., 176
Hodgson, J. F., 84, 85
Hodgson, R. A., 129
Hoffmeister, J. E., 124
Holland, J., 276
Holloway, J. K., 152
Holly, K., 303
Holm, L. G., 146
Holt, R. F., 174
Hooper, F. F., 290
Horak, D. L., 289
Hornbeck, J. W., 132
Howard, G. S., 207
Huff, F. A., 20
Hull, A. C., Jr., 187
Hunderburk, H. H., Jr., 302
Hunt, D. R., 257
Hunter, J. E., 225

Ivanova, T. N., 90

Jackson, L. P., 116
James, G. T., 125
Jameson, D. A., 198
Janes, B. E., 39
Jeffrey, E. A., 311
Jensen, H. R., 356
Jensen, L. D., 298
Johnsen, T. N., Jr. 198
Johnson, C. A., 310
Johnson, H. P., 139
Johnson, L. E., 7
Johnson, W. C., 173
Johnson, W. M., 196
Jones, L. G., 109
Jonsson, I. G., 16
Jutras, P. J., 211

Kaye, C., 122
Kaurichev, I. S., 90
Kearney, P. C., 305
Kemper, W. D., 62
Kepner, R. A., 109
Kerr, H. D., 148
Khomenko, A. D., 60
Kidd, G. J., 250
Kilmer, V. J., 41
Kingsley, Q. S., 14
Kirby, R. R., 252
Klemmedson, J. O., 197
Kline, D. D., 277
Knoll, H. A., 110
Knox, F. E., 108
Krajicek, J. E., 204
Kramer, R. H., 291
Krumholz, L. A., 292
Krupkin, P. I., 168
Kusse, A. D., 49

LaBelle, R. L., 210
Landers, R. H., 238
Langbein, W. B., 23
Larson, W. E., 64, 154
Lathwell, D. J., 110, 158
Lavy, T. L., 86
Lawrence, J. M., 57
Leffel, R. C., 185
Lehane, J. J., 144
Lehman, O. R., 215
Lehr, J. R., 81
Leonard, R. A., 77
Lindberg, H. R., 9
Lipps, R. C., 43
Little, S., 205
Little, W. C., 230
Long, F. W., 17
Long, H. H., 237
Loreen, E., 10
Lorenz, R. J., 42
Ludington, D. C., 313
Lundgren, H., 16
Lunin, J., 167
Lutwick, L. E., 176
Lyles, L., 52, 61, 169

McArthur, J. M., 106
McClung, M. R., 260
McClure, W. T., Jr., 232
McCullough, D. R., 295
Mace, B., 253
MacEachern, C. R., 97, 116
McEvoy, E. T., 83
McGregor, A. J., 104
McKell, C. M., 100
McKercher, R. B., 112

McLean, A. A., 79
MacLeod, L. B., 97, 116
Malde, H. E., 123
Mann, R. K., 261
Mannering, J. V., 180
Manson, G. F., 189
Markwardt, E. D., 210
Mason, J. L., 106, 162
Mateos, M., 25
Mathey, N. A., 254
Mauldin, W. G., 300
Meiners, R. G., 142
Menz, J. A., 55
Mersereau, G. S., 297
Meyer, J. H., 109
Meyer, L. D., 180
Miles, J. R. W., 189
Miltimore, J. E., 106, 162
Minckler, L. S., 204
Minckley, W. L., 292
Molberg, E. S., 222
Morel-Seytoux, H. J., 22
Moreno, E. C., 78, 157
Morgan, G. T., 213
Muckel, D. C., 44
Multer, H. G., 124
Mulvaney, F. E., 286
Murphy, A. H., 199
Muzik, T. J., 151, 300
Myers, V. I., 45

Namken, L. N., 66
Negi, N. S., 302
Nelson, W. W., 220
Nichols, J. M., 264
Nikonov, M. N., 88
Noggle, J, C., 87
Norris, J. J., 135
Nozdrunova, Y. M., 90

Odynsky, W., 118
Ogrosky, H. O., 234
Ohmstede, W. D., 70
Olsen, S. R., 62
Orlob, G. T., 296
Osborn, G., 157
Ostrander, C. E., 308

Pair, C. H., 30, 31, 33
Palmer, L. M., 307
Parker, R. B., 126
Parsons, P. S., 192
Patnode, H. W., 129
Patton, C. R., 242
Pearson, L. C., 195
Pemberton, E. L., 18
Penny, A., 161
Perlin, S. I., 88
Peterson, J. B., 134
Philip, J. R., 32
Phillips, R. L., 51
Phillips, W. M., 221
Pope, L. S., 186
Porterfield, W. A., 58
Pratt, P. F., 76

Ragland, J. L., 102
Raine, J., 212
Raju, M. V. S., 147
Ramsey, N. L., 282
Reeder, S. W., 118
Reedy, G. R., 96
Reid, E. H., 196
Reineke, E., 36
Reinhart, K. G., 13, 132
Reiniger, P., 172
Rennie, D. A., 127
Reynolds, C. W., 39
Rhoades, E. D., 200
Rich, A. E., 225
Richardson, E. C., 41
Riek, H. W., 228
Rippert, W. J., 45
Roadhouse, F. E. B., 306
Roberts, D. R., 191
Roberts, H. A., 303
Robertson, J. C., 263
Robertson, L. S., 214
Robinson, E. L., 219
Robinson, R. G., 220
Robocker, W. C., 148
Roche, B. F., Jr., 151
Rogler, G. A., 42
Romine, D. S., 130
Romsdal, S. D., 156
Ross, R. G., 301
Roth, B. A., 243, 268, 278
Rubin, J., 172
Russell, G. C., 179
Rust, R. H., 128
Ryaboklyach, V. A., 60

St. Arnaud, R. J., 119
Sand, P. F., 219
Sans, W. W., 189
Sasser, J. R., 272
Savage, D. E., 125
Savitskaya, M. N., 60
Schillinger, J. A., Jr. 185
Schleusener, R. A., 170
Schmehl, W. R., 156
Schumacher, C. M., 193
Scott, V. H., 26
Seaman, D. E., 58
Sengupta, M. B., 80
Sewell, J. I., 47
Sexsmith, J. J., 188
Shahroody, A. M., 38
Shannon, W. G., 11
Shaw, R. H., 40
Sheets, T. J., 305
Shipp, R., 249
Shubeck, F. E., 14
Shull, H., 35
Siddoway, F. H., 131
Silkett, V. W., 240
Silvester, R., 21
Sims, P. O., 186
Singh, K. P., 24
Skaife, C. W., 281
Skea, J., 293
Smirnov, P. M., 92
Smith, C. B., 102
Smith, D., 184
Smith, G. S., 274
Smith, J. G., 197
Smith, J. P., 81
Smith, J. W., 305
Smith, L. L., Jr., 291
Smith, R. E., 318
Smith, R. H., 140
Smith, R. L., 103
Smith, S. C., 27
Smith, W. L., 141
Somes, H. A., 205
Soofi, G. S., 114
Stafford, I. B., 3
Staple, W. J., 144
Steeves, T. A., 147
Steinhardt, R., 172
Stevens, W. W., 251
Stewart, D. K. R., 226, 301
Stewart, K. V., Jr., 235
Stickler, F. C., 216
Stokes, W. L., 15
Struchtmeyer, R. A., 39
Stubbe, G. F., 283
Sundquist, W. G., 256
Swanson, N. P., 136

☆ U.S. GOVERNMENT PRINTING OFFICE : 1965 O—774-459

Talbert, R. E., 304
Tanner, H. A., 289
Taylor, A. W., 78
Taylor, R. E., 178
Terman, G. L., 157
Teskey, B. J. E., 209
Thomas, J. R., 294
Thomas, W. I., 102
Thompson, J. R., 220
Thompson, N. R., 223
Thompson, R. L., 220
Thompson, S. O., 74
Thurlow, D. L., 117
Tidwell, H., 248
Tiller, K. G., 84
Timmons, D. R., 174
Tingey, D. C., 149
Tovey, R., 30

Ussery, L. R., 45

Van Doren, C. A., 174
Van Riper, G. E., 181
van Schilfgaarde, J., 46, 47
Valentine, K. A., 135
Vittum, M. T., 39
Voorhees, W. B., 174

Walker, T. M., 293
Walkup, H. G., 255
Ward, A. D., 3
Warder, F. G., 144
Watanabe, F. S., 62
Way, J. M., 224
Webber, L. R., 133
Webster, D. A., 287
Weed, S. B., 77
Welbank, P. J., 145
Whalley, R. D. B., 100
Whiteside, E. P., 119
Widdowson, F. V., 161
Wiese, A. F., 299
Williams, D. A., 265, 270, 275
Williams, H. R., 8
Williams, R. D., 203
Williams, R. J. B., 16
Williamson, R. E., 72
Willis, R., 267
Wilson, G. C. S., 104
Wimberly, J. E., 50
Wit, C. T., de., 87
Wittmuss, H. D., 136
Wolcott, A. R., 94
Wolf, D. C., 309
Wolf, D. D., 184
Woodruff, N. P., 61
Woods, P. C., 296
Work, R. A., 11
Wressell, H. B., 189
Wright, N., 202

Yao, A. Y. M., 40, 175
Young, G., 2

Zaytsev, B. C., 120
Ziemer, R. R., 67
Zmolek, W., 258